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The Bell Telephone Decision. LAST week we gave an extended report of the Bell telephone decision rendered at Washington by the Supreme Court, and we now print the text in full. Pending the publication of the official revision delayed by the sudden death of Chief Justice Waite, we have availed ourselves of the text edited by Mr. Frank L. Pope, whose intimate and expert familiarity with the subject has enabled him to perform that delicate task with eminent success.

Telegraph Schools. MAYOR HEWITT distinguished himself recently by attacking the telegraph schools and by rescuing some of their victims. We are glad to see that the New York *Herald* is now holding up his hands in this campaign, and is itself carrying the war into Brooklyn. The trouble in this work has always been that of bringing home the fraud so as to punish the offender, but where process of law fails, the newspaper press can offer a remedy almost as effective by the publicity they give to the swindle.

Testing Induction Coils. IN this issue Dr. Louis Duncan and his associates begin a series of articles on the methods adopted for determining the various constants in connection with the phenomena presented by alternating currents as employed in the operation of transformers. This article will show the curious manner in which variations are brought about by following the different conditions under which transformer apparatus may be employed in practice. We might add here that the method of testing transformers described by Prof. Ayrton before the London Society of Telegraph Engineers and Electricians, and published in our last issue, is practically identical with that described by Dr. Duncan in THE ELECTRICAL WORLD about a year ago.

The Telephone Fight. IT might be reasonably supposed that the recent decision in the Supreme Court would put an end to legal and other warfare over the telephone, but such is not the case. Little is to be expected from the Government suit, but Dr. Cushman, in Chicago, reports himself ready to renew or continue the fight, while in this city Mr. J. W. Bonta, whose inventions we have noted once or twice, is actively putting forward his alleged make-and-break apparatus, and has strong backing, if the names in the directorate of his company go for anything. Of the various interferences in the Patent Office nothing can be said, except that they remain as before. For the present, as hitherto, the American Bell Company is master of the situation, and as the recent action at St. Louis shows, does not intend to be very merciful to infringers.

State Taxation of Telegraphs. IT has been contended by the Western Union Company that such of its lines as run along military and post roads or over public domain are not liable to State taxation, but an important decision of the United States Supreme Court now puts the company in the wrong. The case heard was that of the State of Massachusetts, where the company has 2,833 miles of line, only 498 of which do not run along post roads; and payment was offered and refused on the the latter mileage. The court now holds that the tax is valid, but the decision of the Circuit Court awarding an injunction to restrain the company from business until the tax is paid is reversed. In other words, the national legislation which allows telegraph companies to run along post roads is permissive, and does not absolve or exempt from the burdens of taxation within any given State.

Long-Distance Telephony. OWING to the ease with which the long-distance telephone lines resisted the great storm a fortnight ago, the service received an advertisement whose good effects with the public it is likely to enjoy for many months to come. Some of our telegraph friends argue that the whole explanation is to be found in the fact that while the long-distance telephone lines were all new, the telegraph lines were all old, but still it is not to be denied that the former were specially well built, being as fine examples of construction as we know of in America to-day. Those who are interested in the subject of long-distance telephony will be glad to read the article we publish this week from M. J. Banneux, the chief engineer of the Belgian telegraphs, an authority in Europe on telephone topics.

Fire-Alarm Systems in England. ONE of the most striking items in our English correspondence, which will be found full of interest this week, is the statement to the effect that but eight towns and cities in all England have fire-alarm systems. An American, familiar with the use of electric fire-alarms in even the smaller towns of this country, experiences some difficulty in bringing himself to believe that such a state of affairs can exist, and one does not see many reasons to account for it. It is true that English towns are more closely built than ours, and it is also true that wood is practically not known as a building material in competition with brick or stone, but admitting this, there are left a large number of places of over 15,000 or 20,000 inhabitants where a fire-alarm system would seem to be a first and absolute necessity. We may be wrong, but it does look as though many English electricians could get profitable employment by working in this neglected field.

A Mulish Antipathy. SOUTHERN mules and horses have evidently a strong antipathy to electric light towers. We have already had occasion to record instances of the overthrow of towers by mules, and now comes the news from Hannibal, Mo., of a like casualty there. It appears that the Mayor of Hannibal blew his nose there the other day with so much vigor and noise that a horse was startled by the loud alarum, dashed down the street, and ran against an electric light tower a hundred feet high, which at once toppled over. We have not yet seen these incidents used as arguments for underground wires, but they prove either great strength on the part of the animals or very great want of strength on the part of the towers. We know of no towers in New York or adjacent cities that could be overthrown by a mule, or by an elephant for that matter, but there is no telling how extreme is the fury with which a Southern mule can be inspired.

Rupture of Incandescent Lamps. A RECENT lamp "freak," which we illustrate in another column, presents a decidedly interesting question as to the actions which take place within an incandescent lamp when subject to influences which cause the disruption of the carbon by an excessive current. The "freaks" heretofore exhibited all show the predominant action of the external air upon the molten glass, causing its rupture by inward pressure. From the nature of the effects exhibited by the lamp described, it seems evident that the vapor produced by the burning of the carbon exceeded in pressure that of the external air, and that the glass was therefore necessarily bulged outwardly at the points where it was heated. The curious formation of the deposit upon the lamp also requires an explanation which probably some of our readers may be able to give. It would be highly interesting, as remarked in a recent note, to determine in this case the amount of pressure existing within the glass globe, by which the truth of the assumption just made might be verified.

Built-Up Dynamo Plants. A CORRESPONDENT in another column suggests an interesting plan for increasing the dynamo capacity of electric light stations by the successive addition of dynamos so that their fields shall be practically one continuous magnetic circuit. Our readers will probably discern that while there would perhaps be no great difficulty in carrying out such a construction, the question of its practicability from an electrical and mechanical standpoint is open to argument. Whether the methods of regulation at present in vogue would completely answer to the requirements of the new arrangement would remain to be determined, and the question of the method of the application of the driving force to the dynamo pulleys would also require serious consideration. It may be remarked, however, that in a recent English design of machine two armatures are placed within the opposite ends of two field magnets, and this design dates even farther back than that, having been applied several years by Marcel Deprez in the construction of a motor.

Storage Battery Construction. THE description of a novel form of storage battery contained on another page, and the method therein described of applying active material to the plate, naturally call to mind the actions which take place in the storage battery and the deteriorating influences there at work. We refer particularly to the position of the active material with regard to the plate. In the usual form of battery the material is so applied that the direction in which the current issues from the plate and passes into the material is usually such that any material loosened will fall in the direction in which the current is passing or is supposed to pass. It might be even assumed that the action of the current itself has a direct tendency to loosen the material, and that in some forms of battery the cell contains, as it were, within itself, the elements of its own destruction, which can only be prevented by the allowance of a liberal surface per ampère capacity of the cell. By adopting a construction, however, in which the direction of the current in passing from the plate to the material is in line with a barrier which forms a support for the active material, a more rational construction seems to be obtained. It has been said that if the storage battery is to become a complete success, a radical change in its construction will have to be brought about, and if this be so, the particular action of the current which we have just noted may be taken as a guide in the construction of future types.

Alternating vs. Continuous Currents. AT the present time the field of the controversy as to the relative values of the alternating and continuous current is in Chicago, where a lively discussion is now going on, and is taken part in by several well-known electricians. In a recent issue we published the conclusions arrived at by Mr. H. Ward Leonard, who, taking up the question on behalf of continuous currents, showed what the advantages are and the distance to which each form of current could be practically operated from central stations. Without entering at this place into these details again, it is interesting to note what those on the other side of the question bring forward to meet the objections raised by Mr. Leonard to the alternating system. Mr. Slattery, in answer to these, lays particular stress on the fact that Mr. Leonard's assumptions and data are incorrect, and that he did not include in his list of vital factors in a general supply system the fact, according to Mr. Slattery, that the alternating system can reach customers and supply a market that the low tension never can. Again, according to Mr. Slattery, Mr. Leonard assumed the cost of copper to be 16 cents per pound, which he was compelled to do in order to bring his estimates within bounds, whereas Mr. Slattery states the price of copper to be nearer 25 cents than 16 cents; and this variation of the price of copper affects the low tension system much more than the high tension alternating. On the question of location of plant Mr. Slattery also drew attention to the fact that whereas in a low tension system the station must be located in the centre of the district to be lighted, thus often necessitating the purchase of valuable property and entailing expense on account of its distance from its source of coal supplies, the alternating high tension station on the contrary may be placed entirely to one side of the district to be lighted and much expense be thereby avoided. Mr. Slattery also took up the other objections raised by Mr. Leonard to the alternating system, such as the inefficiency of the converters at small load and the difficulty of coupling dynamos in parallel, as well as others, and claimed that these difficulties either did not exist, or, if they did, could be overcome, and had already been overcome to a great extent.

Experiments on Induction Coils.

BY DR. LOUIS DUNCAN, CARY T. HUTCHINSON AND GILBERT WILKES, JOHNS HOPKINS UNIVERSITY.

I.

Since the researches of Ewing* and Hopkinson† on the magnetic properties of different specimens of iron under various conditions, it has been evident that the ordinary expressions for the self and mutual induction of circuits containing iron, where one of the circuits has impressed upon it a varying electromotive force, are insufficient. It has been shown that when iron is magnetized the magnetic induction lags behind the magnetic force; and as it is upon the induction that the induced electromotive forces depend, it is evident that this lagging effect—"hysteresis," as Ewing calls it—must be taken into account. Again, in the treatment of induction coils the coefficients of self and mutual induction are taken as constant, while it is well known that the permeability of iron differs with different values of the induction. Another indeterminate factor, and one that may become important under certain conditions, is the statical action of the turns near one another, where there is a considerable and varying difference of potential between them. There are other disturbing causes less marked than the above, but which cannot be altogether ignored.

It is evident that the introduction of these effects in any mathematical treatment of the subject would greatly complicate the equations, making the results, even supposing the equations could be solved, too cumbersome for any practical use. And, in reality, until we have some theory of magnetization it seems useless to attempt, by mathematical analysis, to bring in effects that vary, as Ewing has shown, from such a number of causes. Analysis founded upon well proven laws is of fundamental value and importance, but when it rests upon empiricisms it is as apt to mislead by an appearance of exactness as to bring about any useful result.

It *is* useful, however, in considering such a subject to take some possible type of action and to determine what results will follow if this action takes place. This is what Joubert, Hopkinson, and some others have done in the case of alternating current dynamos and of induction coils fed from them. Joubert‡ found by experiment the curves per E. M. F. and current in the case of a Siemens alternating dynamo, there being little self-induction in the external circuit. These curves proved to be approximately simple sine curves, such as might be represented by the equation:

$$E = E_0 \sin 2\pi \frac{t}{T}; \quad I = I_0 \sin 2\pi\left(\frac{t}{T} - d\right).$$

From the construction of the dynamo in question we would naturally expect some such result. The coils of the armature contained no iron and, as in the experiments, there was no self-induction in the external circuit, the disturbing causes were slight.

Hopkinson,§ considering two dynamos producing periodic E. M. F.'s, showed that they could be coupled in

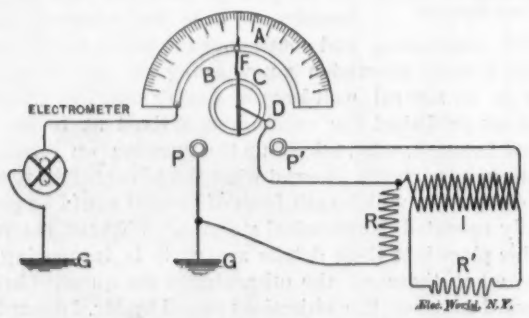


FIG. 1.—EXPERIMENTS ON INDUCTION COILS.

parallel to feed into the same circuit, while they could not be joined in series, and he proved his deductions by experiment. In the problems relating to the subject that he has solved, he assumes a value of E. M. F. given by a sine curve, as have also those who have attacked the subject by graphical methods.

These results are important, provided they are not pushed too far, and give us a very good idea of the types of action that go on in alternating current apparatus. As representing actual values, however, they must at times introduce considerable error.

The only direct experimental investigations of alternating current circuits with which we are acquainted which bear directly on the present subject are the researches of Joubert, Ferraris, and those lately of Prof. Elihu Thomson. The results of the first of these are important, but the experiments were not made under the conditions which we have imposed in our own work, and include only measurements made on the dynamo circuit, this circuit having no self-induction. Ferraris has investigated the phenomenon of retardation experimentally, and has compared his results with the mathematical theory he has deduced. Prof. Thomson has arranged an apparatus by which the movement of a diaphragm acted upon by a magnet around which the current to be investigated flows is made evident. This method, while ingenious, does not give the curves in their true form, nor could it, even if a continuous current were used for calibration, give more than an approximation at absolute values.

In the following experiments we have simply obtained the curves, in some cases of current, in others of E. M. F., between designated points in the primaries and secondaries of two induction coils of different types, together with curves representing the induction in different parts of the field of the dynamo and others giving current and E. M. F. under the various conditions designated.

We hope to continue the experiments when some other work now in progress is completed; especially to find the

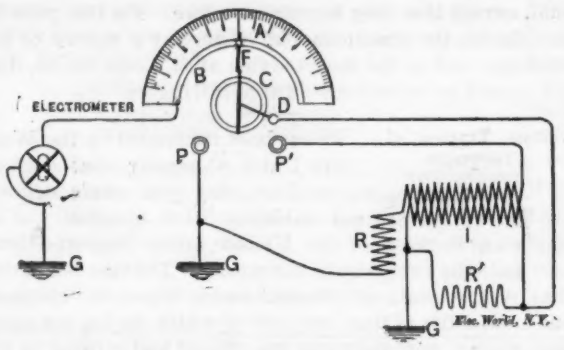


FIG. 2.—EXPERIMENTS ON INDUCTION COILS.

effect of jarring the induction coil during the experiments, the result of which will be to decrease the hysteresis.

APPARATUS AND METHODS.

Dynamo.—The dynamo used for the experiments was of the Siemens alternating type with a separate exciter. There are eight coils in the armature connected in series, and eight pairs of field magnets. The speed was approximately 800 revolutions per minute, giving about 50 complete reversals per second. A peculiarity of the machine lies in the fact that there is no iron in the armature coils. A description of the machine may be seen in almost any book on dynamo machinery, or in Dredge's "Electric Illumination." The electrical constants are given below.

Induction Coils.—Two induction coils of different types were used; one a closed magnetic circuit transformer of the Westinghouse type, the other an ordinary induction coil with a cylindrical core of iron wire, that was constructed in the laboratory.

Methods of Measurement—Self and Mutual Induction.—Several methods were tried for measuring these quantities; for, as a large number of measurements were to be made, we wished to get some method which admitted of quick and easy adjustment. These requirements were best filled by the method described by Mr. Sumpner, * although some of the results were checked by measurements made in different ways.

Strength of Induced Field of Dynamo.—This was measured by using an earth conductor and ballistic galvanometer, with a test coil, in the manner suggested some time ago by Professor Rowland. The test coil in the field whose intensity was to be measured was connected in series with the galvanometer and earth inductor, and the throw of the galvanometer needle caused by reversing the current in the field magnets was compared with the throw obtained by turning the inductor through 180° from a position at right angles to the meridian. Knowing the value of the horizontal intensity of the earth's field and the areas of the earth inductor and test coil, we obtain the strength of the field at the point where the coil is placed.

Two test coils were used, one around the outer, the other in the inner periphery of an armature coil. The positions of the coils were about 11¼ degrees apart; results were obtained for both test coils, and experiments were tried with different currents in the field.

The induction through the cores of the field-magnets was also measured by putting a test coil around the magnets and reversing the current. Different strengths of current were, of course, used. It may be well to point out that in both of these experiments the change in the induction may, without sensible error, be taken as representing twice the number of lines of force passing through the circuits in the first place, the effect being that of a short, thick magnet.

Methods for Obtaining Curves of Electromotive Force and Current.—Platting curves of current and electromotive force, these quantities being taken as functions of the time, resolves itself into obtaining their values for different positions of the armature coils relatively to the poles of the field magnets. Two arrangements for effecting this were used; the first was employed when the primary or dynamo circuit alone was investigated; the second when both primary and secondary circuits were experimented upon. Electromotive forces were measured directly by a quadrant electrometer whose constant was known; currents were measured by observing the E. M. F. at the terminals of a known resistance having no self-induction,

In the first arrangement a brass wiper was clamped on a lug secured to one of the collector rings. This wiper struck lightly but surely against a brass pointer, which could be clamped in any desired position upon a wooden arc, concentric with the axis of the armature. The upper end of the pointer bore a long index arm which traveled in front of a scale and gave the angular position of the pointer, and, therefore, the position of the armature coils with respect to the field magnets at the moment the wiper made contact. Every precaution was taken to prevent leakage, and the insulation of the apparatus was practically perfect.

In experimenting with induction coils where it was necessary to obtain the current and E. M. F. of both primary and secondary circuits, a more efficient apparatus was used, with which the first observations were repeated. A wooden disc *C*, Fig. 1, was securely fastened to the end of the dynamo shaft; on the circumference of this was fixed a brass wiper as in theformer experiments. This wiper touched once each revolution the pointer *F* used before, to which had been added a horizontal arm, long enough to reach the wiper, and heavy and rigid enough to prevent error from its vibrations. From the wiper a brass strip extended across the centre of the disc, and against this bore a spring contact *D*. This contact was joined to the point, whose potential, at different phases, it was desired to measure.

In experimenting on the primary and secondary circuits of an induction coil it was the custom to first obtain the curve for the primary, and immediately afterward that of the secondary. The accompanying diagrams, Figs. 1 and 2, show the methods of connection first, to observe the current in the primary; second, to observe that of the secondary.

The observations consisted in reading the electrometer deflections for positions of the pointer 3 degrees apart, through 180 degrees. The electrometer was then calibrated by a known and constant difference of potential.

The electrometer used was of the Thomson quadrant type, the insulation of which was so good that the needle would retain its charge for several days without appreciable diminution. We found that with the needle charged to its proper potential, it was impossible to measure some of our E. M. F.'s by any of the six methods of connection usually given, even "Grade 6' giving too great a deflection. By reversing the arrangement of "Grade 5," that is, by connecting the induction plate to the source of potential to be measured, earthing the pair of quadrants beneath the induction plate and also the frame of the instrument, and insulating the remaining quadrants, this difficulty was overcome.

* Phil. Trans., 1884.
† Phil. Trans., 1886.
‡Etudes sur les Machines Magnéto-Electriques. Paris. 1881.
§Soc. Tel. Engrs. and Electricians, 1885.

* Jour. Tel. Engrs and Electricians, Vol. xvi., No. 67.

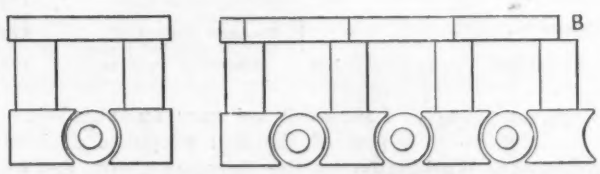
Built Up Dynamo Plants.

BY S. P. VAN NORT.

I have a plan or idea which I would like to offer the electrical fraternity if it is worth anything.

If a man desires to build a plant of any kind of machinery, for which he will want several boilers, it would be considered very bad practice if he built a separate furnace for each boiler and set each boiler and furnace separately and removed from the others. He would set them all together in one plant or furnace, as a matter of course, to save coal and prevent radiation of heat.

Now in a dynamo, magnetism is radiated in much the same manner as heat from a boiler, or at least it is impossible to utilize all the magnetic lines of force, because



FIGS. 1 AND 2.—BUILT-UP DYNAMO PLANTS.

they radiate in all directions from a pole. In a well constructed dynamo, it is true that a large proportion of these lines are utilized, especially where the fields are end on to the armature. The plan I propose is better suited, I think, to large plants.

It is to have all the fields connected magnetically or to have all the fields built together, iron to iron, as I have attempted to show more clearly in the accompanying diagrams. Fig. 1 is a single machine, and Fig. 2 shows several machines combined, so as to place an armature on both sides of each pole in the field except the first and last poles which form the ends of the plant. The idea is to increase the size of plant by building another field on at *B* and placing another armature between the poles thus formed, when needed. The system is applicable to many types of machines. It will be seen that my idea is to catch as many of the lines of force as possible.

Electrolysis.

When an electric current passes from a solution of certain metallic salts with the atmosphere of gas or vapor immediately above such solution, an electrolytic separation of the metal takes place at the surface of the liquid. M. J. Gubkin has recently described (Ann. Phys. & Chem.) certain apparatus by means of which this is made evident, and in which a partial vacuum may be produced above

the liquid. Silver and platinum are found to separate out in films which float on the surface; while zinc, in contact with air, oxidizes as it separates, the white flakes of zinc oxide gradually falling to the bottom of the liquid.

New Switch on the Julien Electric Car.

If electric traction is to become universal, the equipment of the car must be such, necessarily, as to leave the driver as free as possible from care in its manipulation, and for that reason considerable ingenuity has been displayed in centring the regulating apparatus of the car in one piece of

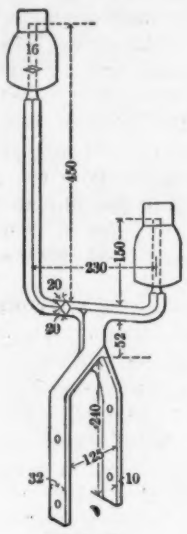


FIG. 3.

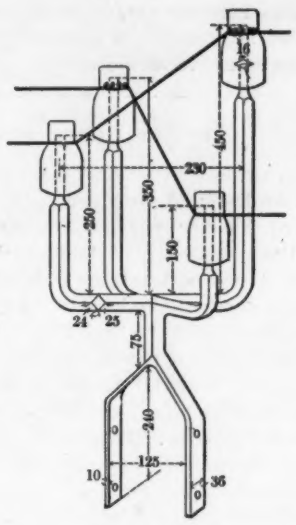


FIG. 4.

mechanism. This idea has been carried out in a very ingenious manner in the cars now being equipped by the Julien Electric Traction Company for the Fourth Avenue Railroad in this city.

The switch, which is illustrated in the accompanying engraving in perspective and in plan view, consists of a cylindrical commutator inclosed in a box placed upon the platform of the car, and from the top of which projects a handle within convenient grasp of the driver. Upon the top of the switch are placed figures which denote relative positions of the arm and commutator which correspond to various methods of coupling of the storage batteries upon the car, so that varying speeds and power may be attained. One of the troubles heretofore experienced in switches of this nature is the sparking which takes place between the commutator sections and the contact brushes touching them, which rapidly burns out the commutator and often destroys the insulation between its sections. To avoid this the present switch is so constructed that at every movement of the handle to obtain a different coupling of the batteries the circuit is first broken outside at a point other than at the commutator contacts. The consequence is that the spark, if any, is all spent upon this one point, which is especially constructed to withstand it, and which can be readily replaced when necessary. Another feature of the arrangement for centring everything in one handle is the provision which has been made for ringing the alarm bell on the car. The button by which this is accomplished is situated, as will be seen, at the end of the switch handle, so that by merely pressing the button with his thumb the driver can draw attention to the approach of the car and still maintain control of the switch at the same time. Several other improvements are being introduced into the cars that are now being equipped, and they bid fair to show the practicability of electric traction by this method.

An Electric Detective Camera.

Electricity has long been applied to the detection of crime, as is well exemplified in the burglar alarm systems so extensively employed; and it is now proposed to apply the same force to the capital punishment of criminals. This branch of applied electricity has, however, just been broadened by an apparatus designed by Messrs. Edward N. Bliss and James F. Middleton, of Newark, N. J., who have constructed an electric detective apparatus which is calculated to aid considerably in the detection and punishment of crime. This apparatus, which is shown in two views in the accompanying illustrations, consists of a photographic camera which is designed to be set up in

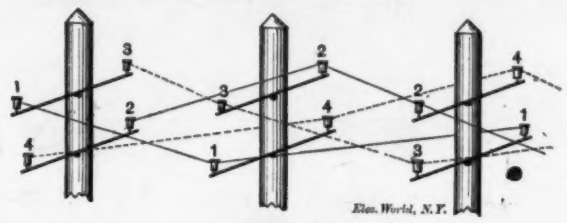


FIG. 1.

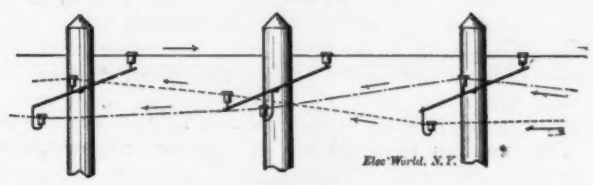


FIG. 2.

banks or stores and, while protected from view, will be focussed upon a point at which a customer would naturally stand or to which he could be led without suspicion. In a bank, for example, it is proposed to fix the camera in the wall back of the teller and so to arrange the lens that the teller's window will be at the focus. The electrical devices are so connected with the camera that by closing the circuit once the camera shutter will be opened and closed, the exposure made, the plate dropped and a new plate inserted in its place. The camera contains a receptacle for the plates in the form of a slotted drum, which is adapted to be rotated over a passage extending past the camera window, and communicating with a similar storing drum below. Each slit in the upper drum contains a plate, and as the slits arrive opposite the passage successively, the plates are successively dropped and, after exposure, are carried into the lower drum. In a bank the button will be placed under the teller's desk. Thus, whenever a suspected person presents a paper at the window, the teller can press the button and get a correct negative of the "suspect" for future reference and inspection. This can be done without attracting the attention of the person himself. Usually a clock giving the year, day, month and hour will be located above the window and be shown on the negative.

The apparatus is designed also to be useful for supplying the rogues' gallery with improved likenesses. It is often difficult to get good pictures of criminals, owing to their efforts to change their appearance when brought before the camera. At a station equipped with the detective apparatus, criminals can now easily be photographed without their knowledge, and while their features are in repose.

It is also expected that the apparatus will be used by lecturers for dropping stereopticon plates.

Overhead Circuits for Long-Distance Telephony.*

BY M. J. BANNEUX (CHIEF ENGINEER OF THE BELGIAN TELEGRAPHS).

For long-distance telephony a metallic circuit is an absolute necessity, as with a single wire and an earth return it is impossible to avoid the noises due—first, to earth currents; second, to induction from neighboring wires; third, to the "picking up" of the currents from other circuits in the vicinity working also with earth returns. As an example of the last the author mentions an overhead wire in Brussels which made earth some fifty yards from a Morse instrument. The two wires ran at right angles to each other, so that there could be no appreciable induction between them, yet every Morse signal could be heard on the telephone line.

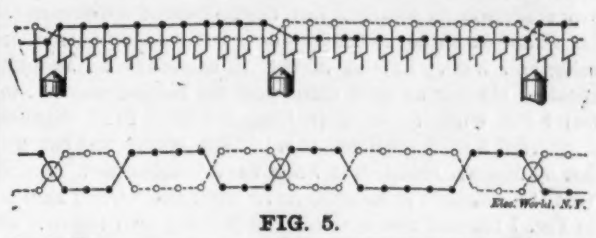


FIG. 5.

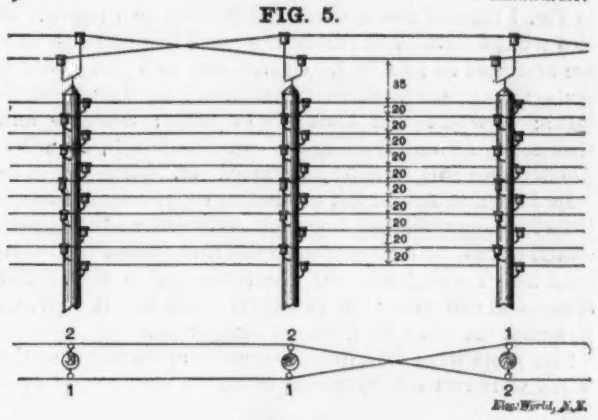


FIG. 3a.

LONG DISTANCE TELEPHONE CIRCUITS.

The best method of stopping cross-talk, due to leakage, is, the author considers, the English method of using good insulators and joining all their iron supports to an earth wire at each station; most of the leakage current then gets to the earth instead of into the other wires.

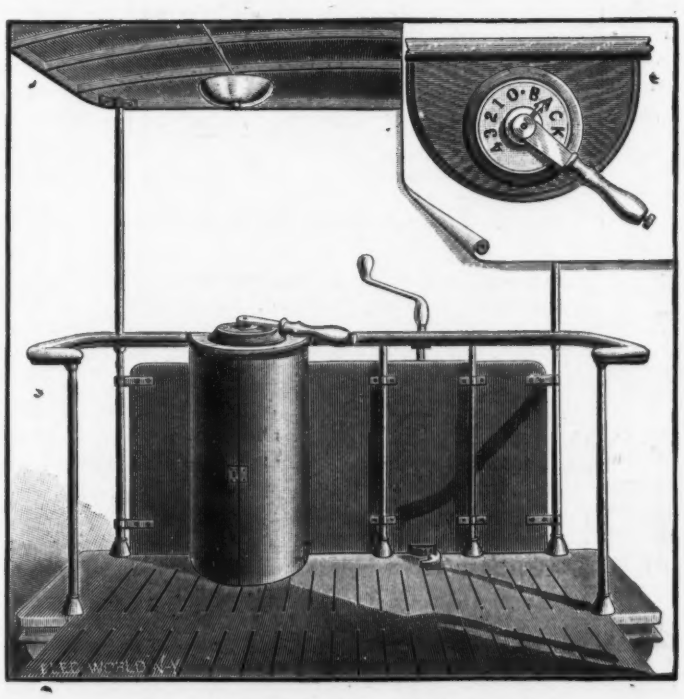
Induction from wire to wire is the other *bête noir* of telephonists, and to it many operators attribute cross-talk which is really due to leakage. It is true, however, that in foggy climates it is very difficult to determine which is the real offender.

The effect of one wire on another is represented approximately by the formula,

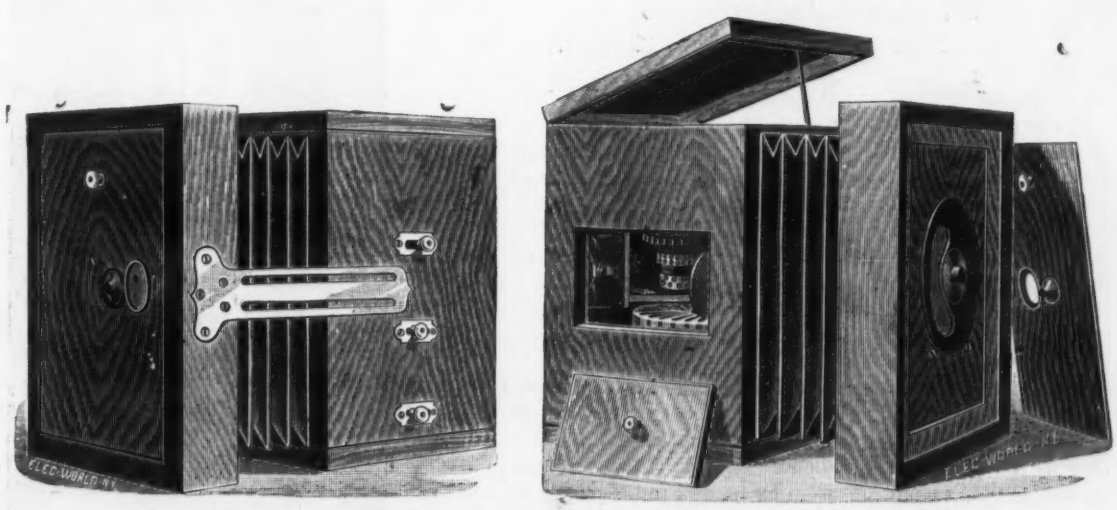
$$m = 2\,l\left(\frac{\log_e 2\,l}{d} - 1\right),$$

where m is the coefficient of mutual induction, l the length of the two wires running parallel, and d their distance apart. The general solution of the difficulty of induction, whatever may be the inducing causes, is to use two wires in a complete metallic loop instead of a single wire and an earth return, and to so arrange them that the sum of the

* Abstract of a paper read before the Société Belge des Electriciens.



NEW SWITCH ON JULIEN CAR.



FIGS. 1 AND 2.—AN ELECTRIC DETECTIVE CAMERA.

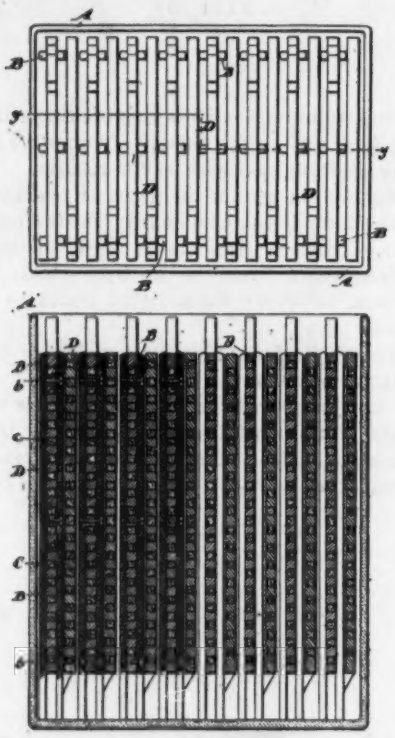
inductions of neighboring telegraph or telephone wires shall be exactly the same on both the wires of the loop. This principle was patented by Bell in 1877, and its efficacy was proved by Hughes in 1879.†

It was applied by Brooks, of Philadelphia, to cables, by twisting the two wires of the loop together.

If a line of poles only carries one telegraph wire and a looped telephone wire it is very easy to obtain equal induction on both wires of the loop; all that is necessary is to run the telegraph wire parallel to its neighbors and equidistant from both of them. The telegraph wires, however, in practice are numerous, and vary in number from section to section, and the telephone wires cannot be arranged so as to be equidistant from each particular telegraph wire. In this case it is necessary to adopt a method similar to that employed for cables, namely, to twist the wires together in long helices. Prof. Hughes suggested a plan for doing this in 1879, which was carried out by Messrs. Moseley & Sons near Manchester. Since 1881 the English post-office have used the wiring shown in Fig. 1 for the trunk wires for joining two towns. If two trunks have to be run on the same line of poles they are arranged as in Fig. 2. Galvanized iron lines on this system are at work between Manchester and Liverpool, 30 miles; Newport and Cardiff, 13 miles; Glasgow and Greenock, 25 miles; Glasgow and Edinburgh, 36 miles; London and Brighton, 54 miles, etc., etc.

In June and July, 1883, the Belgian Government established communication between Antwerp and Brussels, which towns, by the way, were the first two on the continent which were joined by the telegraph in 1846. The trunk was run along the railways, using No. 16 S. W. G. phosphor-bronze wire, about 16 lbs. per mile.

The posts were not provided with cross-arms, so the wires were run on the special brackets, which were fixed



FIGS. 1 AND 2.—NEW GIBSON STORAGE BATTERY.

on the top of the posts as shown in Figs. 3 and 3A. The line was remarkably quiet; a slight fizzling was heard at times, but conversation could be carried on as easily as between two subscribers in one town. Both Blake and Van Rysselberghe transmitters were used.

Van Rysselberghe's system was applied to the Belgian telegraph lines during 1884, and the first line opened to the public in October. At the present moment (Nov. 1887) there are some 1,800 miles of double wire used simultaneously for telegraph (Morse and Hughes) and for telephone inter-urban trunk lines.

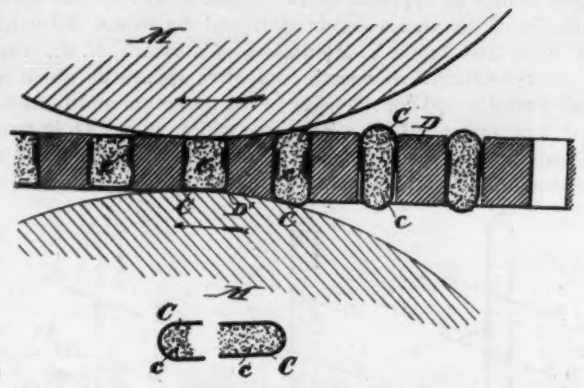
The author then proceeds to describe the Paris-Brussels line. It was agreed between the representatives of the two countries that the line should be a closed metallic circuit of No. 11 S.W.G. high conductivity wire, to be run on the telegraph posts on the railway, and to be protected from induction as far as possible, the means to be employed to do so being left to the respective governments.

The whole air line, 195 miles, was run in three weeks in the months of December, 1886, under great difficulties from bad weather. The length of the Belgian section is 48 miles. It starts from the Bourse in Brussels, and the Paris end is joined on to the Bourse there by an underground lead cable 3 miles long.

The Belgian part of the line is run in phosphor-bronze; the French is silicium bronze. Great care had to be taken with the insulators, as good insulation was as important as freedom from induction. The system of running on the top of the poles, which had been found so satisfactory on the Brussels-Antwerp line, was adopted. But, rightly or wrongly—the author thinks the latter—the wire running department objected to the idea of the wires crossing vertically in the air, on the score of danger of wind contacts. (By a vertical cross is meant that between two poles the two wires remain respectively on the same sides of the poles, but exchange their levels, as opposed to a horizontal cross, when they retain the same respective levels, but exchange sides.)

† *Journal* Soc. Tel. Eng., Vol. VIII., 1887.

A four-branch bracket, Fig. 4, was therefore used, so that all vertical crossings take place at the posts. The four insulators are undesirable, as every additional insulator offers an additional chance of leakage. It was found to be sufficient, however, between stations to put in a four-way bracket, and reverse vertically at every thirtieth or thirty-fifth post, and between these to reverse horizontally backwards and forwards at every sixth or seventh span,



FIGS. 4 AND 5.—METHOD OF MAKING GIBSON PLATES.

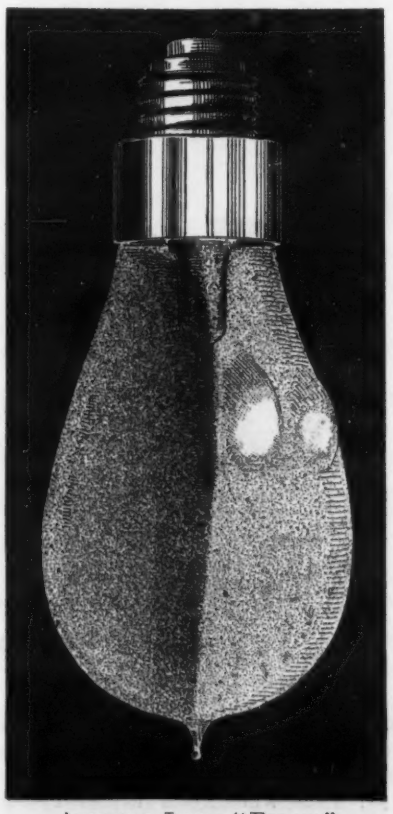
using brackets of the type already shown in Fig. 3. Fig. 5 is a diagram of a portion of the line passing by the railway station at Mons, where the wires are crossed horizontally at more frequent intervals. This method does not entail cutting the wires, so that there are no more joints than in direct running.

The line was first opened on February 24, 1884, and the public can judge whether it works satisfactorily or not. As to the engineers of the two administrations, accustomed as they are to almost daily faults on a telegraph line of such a length, they are delighted with the perfect way it conducts itself. The greater part of the faults which have occurred have been in Brussels, where the house painters have occasionally short-circuited the overhead wires. The same wires are used simultaneously for telegraphy on the Van Rysselberghe system. The insulation and conductivity of the line were proved when, one winter's day, all the other telegraph wires having become unusable, the Hughes instrument got through to Paris at full speed on the telephone wires.

The two wires of the line must be alike in material and insulation. The line ceased to be silent, for example, when a Bell telephone was interposed at the frontier in one of the wires, or if one of them touched a tree branch or a damp wall.

Another Lamp Freak.

The publication of an interesting case of lamp fracture and the discussion thereon which appeared in our columns has brought the subject forward so prominently that another case, somewhat out of the usual run, which has come to our notice, may be of interest to our readers. This freak, illustrated in the accompanying engraving, is a lamp which was employed on a high tension circuit in series with a number of others and the filament of which was destroyed by an excessive current caused by a short circuit. In the freaks which we and our correspondents have heretofore described, the fracture of the glass globe was brought about by the pressure of the air forcing the softened glass inwardly until rupture finally took place.



ANOTHER LAMP "FREAK."

In the present instance, however, the action was quite different. As will be seen, the glass globe is not fractured, and instead of the glass being forced in by the pressure of the air, it has, on the contrary, been forced outwardly in two places quite close together, forming as it were two small bumps. At the time that this formation took place, the lamp was fixed horizontally in a socket, and the bumps formed were exactly at the top of the lamp and almost directly in line with the points at which the leading in wires are attached to the filament.

Another curious feature of this case is the fact that the lamp was blackened over more than three-quarters of its entire interior surface, but a zone extending from the holder to the tip and including the two bumps is covered by a whitish deposit, which is most prominent at the points where the excrescences appear. There can also be noticed faint traces of a greenish deposit mixed among the white above mentioned.

The New Gibson Storage Battery.

Our readers will remember that in the type of storage battery designed some time ago by Mr. Charles D. P. Gibson, of this city, the active material was inserted in perforations made in a slanting direction through a lead plate, which perforations were subsequently sealed by the closing down of the burs of lead formed by the perforating process. In the new type of battery which Mr. Gibson has designed, a novel method is employed of applying the active material to the plate, and special pains have been taken to secure the proper insulation of the plates of opposite polarity. This is accomplished by inserting the active material in capsules which are placed in perforations made in the plate and which are then rolled so as to bind the capsules tight within the holes in the plate.

The accompanying illustration, Fig. 1, shows a vertical section of the battery taken on the line *y y* of the plan view, Fig. 2. One of the plates and the accompanying insulating strips are shown in Fig. 3, while Fig. 5 shows the manner in which the capsules are built up. They consist of the two cup shaped capsules *C*, which are filled

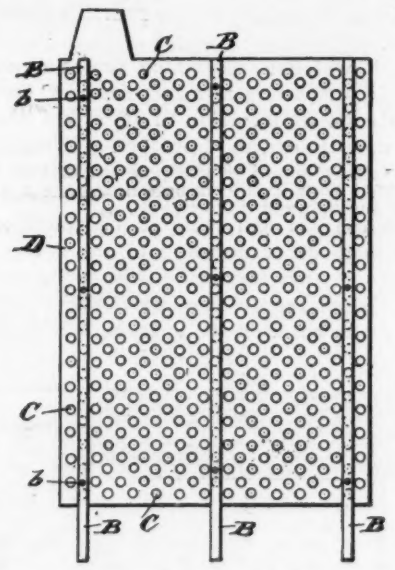


FIG. 3.—PLATE IN NEW GIBSON STORAGE BATTERY.

with peroxide of lead *c*, in the form of paste. The ends of the capsules, it will be noted, are perforated so as to allow the air to pass out when the active material is forced into them and to allow of the entrance of the elect rolyte when the plate is placed in the latter.

The capsules when formed are inserted in the holes of the plate, in which they fit loosely, and they are of such size as to project somewhat beyond the surface. When a plate is thus prepared it is passed through a set of rolls *M*, and by pressure the capsules are compressed endwise so as to shorten and thicken them, as shown in Fig. 4. After this process the plate is perfectly smooth, the thin coating of metallic lead which covers the active material remains intact and forms a protection for the same. The rolling action "upsets" the capsules and compresses them against the adjacent metal, which action distorts the metal and causes the material of the plate to overlap and clinch the capsule, as shown at *D'* on Fig. 4. The insulating strips *B*, below the plates serve as footpieces, with a step on one side of each plate to support the oxygen plate. The insulating strips are fastened to the hydrogen plate with a row of step insulations on one side. By this construction the oxygen plate can be readily removed when it becomes necessary to examine the battery, and the insulation mechanically supports the plates. Mr. Gibson attaches special importance to the encasing of the peroxide in the capsules because of the convenience and reliability of its retention.

Flying Machines.—A man with a flying machine has arrived from Cuba to get Mr. Edison to build an electric motor for him. It will be remembered that Mr. Edison's own idea of a flying machine is a long cigar-shaped kind of balloon, with a car beneath to which are attached two long poles. The aeronaut is supposed to pole himself along, dancing over the ground, so to speak, on the two stilts.

The Decision of the United States Supreme Court in Favor of Bell.*

The CHIEF JUSTICE—I have been instructed by the Court to announce its judgment this morning in the six cases known as the telephone cases, and as the opinion is rather long, and my voice is weak and not under control, I have asked Judge Blatchford to read it.

Mr. JUSTICE BLATCHFORD—This opinion is in case No. 113, *Amos E. Dolbear* and other appellants, versus *The American Bell Telephone Co.*, an appeal from the Circuit Court of the United States for the district of Massachusetts.

In cases No. 361 and 362, which are cross-appeals from the Circuit Court of the United States for the Southern District of New York, one by the *Molecular Telephone Co.* and others, appellants, against *The American Bell Telephone Co.* and another, and a cross-appeal by *The American Bell Telephone Co.* and another, versus *The Molecular Telephone Co.* and others.

Another case is No. 709, *The Clay Commercial Telephone Co.* and others, appellants, versus *The American Bell Telephone Co.* and others, an appeal from the Circuit Court of the United States for the Eastern District of Pennsylvania.

Another is case No. 770, *The People's Telephone Co.* and others, appellants, against *The American Bell Telephone Co.* and others, an appeal from the Circuit Court of the United States for the Southern District of New York.

Another is case No. 771, *The Overland Telephone Co.* and others, appellants, against *The American Bell Telephone Co.* and others, an appeal from the Circuit Court of the United States for the Southern District of New York.

The opinion is written by the Chief Justice.

BELL'S CLAIM FOR THE ART.

The important question which meets us at the outset in each of these cases is as to the scope of the fifth claim of Bell's patent of March 7, 1876, which is as follows:

> The method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth.

It is contended that this embraces the art of transferring to or impressing upon a current of electricity the vibrations of air produced by the human voice in articulate speech in such a way that the speech will be carried to and received by a listener at a distance on the line of the current. Articulate speech is not mentioned by name in the patent. The invention, as described, consists in the employment of a vibratory or undulatory current of electricity, in contradistinction to a merely intermittent or pulsatory current, and of a method of and apparatus for producing electrical undulations upon the line wire.

A pulsatory current is described as one caused by sudden or instantaneous changes of intensity, and an electrical undulation as the result of gradual changes of intensity, exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations.

Among the uses to which this art may be put, is said to be the telegraphic transmission of noises or sounds of any kind; and it is also said that the undulatory current, when created in the way pointed out, will produce through the receiver at the receiving end of the line a similar sound to that uttered into the transmitter at the transmitting end. One of the means of imparting the necessary vibrations to the transmitter to produce the undulations may be the human voice. Articulate speech is certainly included in this description, for it is an uttered sound produced by the human voice.

It is contended, however, that "vocal sounds" and "articulate speech" are not convertible terms, either in acoustics or in telegraphy. It is unnecessary to determine whether this is so or not. Articulate speech necessarily implies a sound produced by the human voice. As the patent, on its face, is for the art of changing the intensity of a continuous current of electricity by the undulations of the air caused by the sonorous vibrations, and speech can only be communicated by such vibrations, the transmission of speech in this way must be included in the art. The question is not whether vocal sounds and articulate speech are used synonomously as scientific terms, but whether articulate speech is one of the vocal or other sounds referred to in this claim of the patent. We have no hesitation in saying that it is, and that if the patent can be sustained to the full extent of what is now contended for, it gives to Bell, and those who claim under him, the exclusive use of this art for that purpose until the expiration of the statutory term of his patented rights.

In this art, or what is the same thing under the patent law, this *process*, this *way* of transmitting speech, electricity, one of the forces of nature, is employed; but electricity left to itself will not do what is wanted. The art consists in so controlling the force as to make it accomplish the purpose.

It had long been believed that if the vibrations of air caused by the voice in speaking could be reproduced at a distance by means of electricity, the speech itself would be reproduced and understood. How to do it was the question. Bell discovered that it could be done by gradually changing the intensity of a continuous electrical current, so as to make it correspond exactly to the changes in the density of the air caused by the voice. This was his art. He then devised a way in which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use. In doing this, both discovery and invention, in the popular sense of those terms, were involved; discovery in finding the art, and invention in devising means of making it useful; and for such discovery and such invention, the law has given the discoverer and inventor the right to a patent; as discoverer, for the useful art, process and method of doing the thing he has found, and as inventor, for the means he has devised to make the discovery one of actual value. Other inventors may compete with him for the ways of giving effect to the discovery, but the new art he has found will belong to him and those claiming under him, during the life of his patent. If another discovers a different art or method of doing the same thing, reduces it to practical use, and gets a patent for his discovery, the new discovery will be the property of the new discoverer, and thereafter the two will be permitted to operate, each in its own way, without interference by the other. The only question between them will be whether the second discovery is in fact different from the first.

A patent for the art does not necessarily involve a patent for the particular means employed for using it. Indeed, the mention of any means in the specification or descriptive portion of the patent, is only necessary to show that the art can be used; for it is only useful arts, arts which may be used to advantage, that can be made the subject of a patent. The language of the statute is:

> Any person who has invented or discovered any new or useful art, machine, manufacture or composition of matter may obtain a patent.

That is section 4886 of the Revised Statutes. It is an art, a process which is useful, and is as much the subject of a patent as a machine, manufacture or composition of matter. Of this there can be no doubt. It is abundantly supported by the authorities. *Corning* v. *Burden*, 15 How., 252-271. *Tilghman* v. *Proctor*, 12 How., 707-735. *Fermentation Company* v. *Maus*, 20 Fed. Rep., 725.

What Bell claims is the art of creating changes of intensity in a continuous current of electricity exactly corresponding to the changes of density in the air caused by the vibrations which accompany vocal or other sounds, and of the use of the electric condition that is thus created for sending and receiving articulate speech telegraphically. For that, among other things, the patent of 1876 was, in our opinion, issued, and the point to be decided is, whether as such a patent it can be sustained.

In *O'Reilly* v. *Morse* (15 How.) it was decided that a claim in broad terms for the use of the motive power of the electric or galvanic current for making intelligible characters, letters or sounds at any distance, although a new application of the power was made by Morse, was void, because it was a claim for a patent for an effect produced by the use of electro-magnetism, distinguished from the process or machinery necessary to produce it.

But a claim for making use of the motive power of magnetism when developed by the action of said current, substantially as set forth in the foregoing description, as a means of operating or governing the motion or machinery that is to impart signals in any desired manner for the purpose of producing telegraphic communication at any distance, was sustained. The effect of the decision was, therefore, that the use of magnetism as a motive power, without regard to the particular process with which it was connected in the patent, could not be claimed; but that its use in such a connection could.

In the present case the claim is not for the use of a current of electricity in its natural state, as it comes from the battery; but for putting a continuous current in a closed circuit into a certain specific condition suited to the transmission of vocal and other sounds, and using it in that condition for that purpose. So far as at present known, without this peculiar change in its condition, it will not serve as a medium for the transmission of speech, but with the change it will. Bell was the first to discover this fact and how to put such a current into such a condition. What he claims is its use in that condition for that purpose, just as Morse claimed his current in his condition for his purpose. But we see nothing in the Morse case to defeat Bell's claim. On the contrary it is in all respects sustained by that authority. It may be that electricity cannot be used at all for the transmission of speech except in the way Bell has discovered it, and that, therefore, practically his patent gives him its exclusive use for this purpose. But that does not make his claim one for the use of electricity as distinguished from the particular process with which it is connected in his patent. It will, if it is true, show more clearly the great importance of his discovery, but it will not invalidate his patent.

SUFFICIENCY OF THE SPECIFICATION.

But it is insisted that his claim cannot be sustained, because when the patent was issued Bell had not, in fact, completed his discovery. While it is conceded that he was acting on the right principle and had adopted the true theory, it is claimed that his discovery lacked that practical development which was necessary to make it patentable. In the language of counsel "there was still work to be done, work calling for the exercise of the utmost ingenuity and calling for the very highest degree of practical invention."

It is quite true that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard and understood by the listener at the receiving end of his line, but in his specification he did describe accurately and with admirable clearness his process, that is to say the exact electrical condition that must be created to accomplish the purpose. He also described with sufficient precision to enable one skilled in such matters to make it, a form of apparatus, which if used in the way pointed out, would produce the required effect, receive the words and carry them to and deliver them at the appointed place. The particular instrument which he had, and which he used in his experiments, did not under the circumstances in which it was tried reproduce the words spoken so that they could be clearly understood; but the proof is abundant and of the most convincing character that other instruments carefully constructed and made in exact accordance with the specifications without any additions whatever have operated and will operate successfully. A good mechanic of proper skill in matters of the kind can take the patent and by following the specification strictly, can, without more, construct an apparatus which, when used in the way pointed out, will do all that it is claimed the method or process will do.

Some witnesses have testified that they were unable to do it, but this shows that they, with the particular apparatus they had and the skill they employed in its use, were not successful; not that others with another apparatus perhaps more carefully constructed or more skilfully contrived would necessarily fail. As was said in *Loom Company* v. *Higgins*, when the question is whether a thing can be done or not, it is always easy to find persons to show how not to do it. If one succeeds, that is enough, no matter how many others fail. Opposite results will show that in the one case the apparatus used was properly made, and carefully adjusted with a knowledge of what was required, and skillfully used; and that in the other it was not. The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing the art to the highest degree of perfection. It is enough if he describes the method with sufficient clearness and precision to enable those skilled in the matter to understand exactly what the process is, and if he points out some practicable way of putting it in operation. This Bell did.

He described clearly and distinctly his process of transmitting speech telegraphically by creating changes in the intensity of a continuous current or flow of electricity in a closed circuit, exactly analogous to changes of density in the air occasioned by the undulatory motion given to it by the human voice in speaking. He then pointed out two ways in which this might be done, one, by the vibration or motion of bodies capable of inductive action or by the vibration of the conducting wire itself in the neighborhood of such bodies; and the other by alternately increasing and diminishing the resistance of the circuit or by alternately increasing and diminishing the power of the battery. He then states that he prefers to employ for his purpose an electro-magnet having a coil on one of its legs, and he describes the construction of the particular apparatus, shown in the patent as Fig. 7, in which the electro-magnet or magneto method was employed. This was the apparatus which he himself used without entirely satisfactory results, but which Professor Cross, Mr. Watson, Doctor Blake, Mr. Pope and others, testify has done and will do what was claimed for it, transmit speech successfully, but not as well indeed as another constructed upon the principle of the microphone or variable resistance method.

THE PATENT NOT LIMITED TO SPECIFIC APPARATUS

An effort was made in the argument to confine the patent to the magneto instrument, and such modes of creating electrical undulations as could be produced by this form of apparatus, the position being that such an apparatus necessarily employed a closed circuit incapable of being opened, and a continuous current incapable of being intermittent. But this argument ignores the fact that the claim is, first, for the process and, second, for the apparatus. It is to be read, as *first*, a claim for the method of transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of air accompanying the vocal or other sounds substantially as set forth, and, *second*, for an apparatus for transmitting vocal or other sounds telegraphically as herein described, by causing electrical undulations, substantially as set forth.

The *method* "as herein described," is to cause gradual changes in the intensity of the electrical current used as the medium of transmission, which shall be exactly analogous to the changes in the density of the air occasioned by the peculiarities in the shapes of the undulations produced in speech, in the manner substantially as set forth; that is to say, by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighborhood of such bodies, which is the magneto method; or by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery, which is the variable resistance method. This is the process which has been patented, and it may be operated in either of the ways specified. The circuit must be kept closed to be used successfully; but this does not necessarily imply that it must be so constructed or so operated upon as to be incapable of being opened. If opened, it will fail to act for the time being, and the process will be interrupted; but there is nothing in the patent which requires it to be operated by instruments which are incapable of make and break. The *apparatus*, "as herein described," which is included in the claim, is undoubtedly one in which the electro-magnet is employed, constructed substantially as set forth in the specification. The one acting on the variable resistance mode is not described, further than to say that the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current; and no very specific directions are given as to the manner in which it must be constructed. The patent is both for the magneto and variable resistance *methods* and particularly for the magneto *apparatus* which is described or its equivalent. There is no patent for any variable resistance *apparatus*.

It is undoubtedly true that when Bell got his patent he thought the magneto method was the best. Indeed, he said in express terms he preferred it. But that does not exclude the use of the other, if it turns out to be the most desirable way of using the process under any circumstances. Both forms of apparatus operate on a closed circuit by a gradual change of intensity, and not by alternately making and breaking the circuit or by sudden and instantaneous changes, and they each require to be so adjusted as to prevent interruptions. If they break, it is a fault, and the process stops until the connection is restored.

It is again said that the claim, if given its broad construction, is virtually a claim for speech transmission by transmitting it, or in other words, for such doing of the thing as is provable by doing it. It is true Bell transmits speech by transmitting it; and that long before he did so it was conceived by scientists that it could be done by means of electricity, if the requisite electrical effect could be produced. Precisely how that subtle force operates under Bell's treatment, or what form it takes no one can tell. All we know is, that he found that by changing the intensity of a continuous current so as to make it correspond exactly to the changes in density of the air caused by sonorous vibrations, vocal and other sounds could be transmitted and heard at a distance. This is the thing to be done. Bell discovered the way of doing it. He uses electricity as the medium for that purpose just as air is used within speaking distance. In effect, he prolongs the air vibrations by the use of electricity. No one before him had found out how to use electricity with the same effect. To use it with success it must be put in a certain condition. What that condition was he was the first to discover, and with his discovery he astonished the scientific world. Professor Henry, one of the most eminent scientists of the present century, spoke of it as the greatest marvel hitherto achieved by the telegraph. The thing done by Bell was the transmitting of audible speech through long telegraph lines. Sir William Thomson on returning to his home in England in August or September, 1876, after seeing at the Centennial Exhibition in Philadelphia what Bell had done and could do by his process, spoke in this way of it to his countrymen:

> Who can but admire the hardihood of invention, which devised such a slight means to realize the mathematical conception, that if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of the current must vary continuously as nearly as may be in simple proportion to the velocity of the particle of air engaged in constituting the sound.

Surely a patent for such a discovery is not to be confined

* Reprinted from the special bulletin of *The Electrical Engineer*, N. Y., March 22. Opinion delivered March 19, 1888.

to the mere means he improvised to prove the reality of his conception.

BELL'S METHOD NOT IN REIS' APPARATUS.

We come now to consider the alleged anticipation of Philipp Reis; and here it is to be always kept in mind that the question is not whether the *apparatus*, devised by Reis to give effect to his theory, can be made with our present knowledge to transmit speech; but whether Reis had in his time found out a way of using it successfully for that purpose, not as to the character of the apparatus, but as to the mode of treating the current of electricity on which the apparatus is to act, so as to make that current a medium for receiving vibrations of air created by the human voice in articulate speech at one place, and in effect delivering them at the ear of the listener in another place. Bell's patent is not alone for the particular apparatus that he describes, but for the process that apparatus was designed to put into use. His patent would be just as good if he had actually used the Reis apparatus in developing the process for which it was granted. That Reis knew what had to be accomplished in order to transmit speech by electricity is very apparent, for in his first paper he said:

Since it is possible to produce anywhere or in any manner vibrations whose curves shall be the same as those of any given tone or combination of tones, we shall receive the same impression as that tone or combination of tones would have produced on us.

Bourseul also knew before Reis that this was the case, for in a communication published in the Paris journals in 1854 he said:

When you reproduce precisely these vibrations, to wit, the vibrations made by the human voice in uttering syllables, you will reproduce precisely those syllables.

Reis discovered how to reproduce musical tones, but he did no more. He could sing through his telephone, but he could not talk. From the beginning to the end he has conceded this. In his first paper he said:

Hitherto it has not been possible to produce the tones of human speech with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree. The cause of this I will attempt to explain.

And again:

I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments, and even to a certain extent the human voice.

None of the many writers whose papers are found in the records claim more than this for Reis or his discovery. Although his first paper was published in 1861, Bell did not appear as a worker in the same field of scientific research until nearly 15 years afterwards. No advance had been made by the use of what Reis had contrived, nor by the use of his method, towards the great end to be accomplished. He caused his instrument to be put in the market for sale, and both he and those he employed for that purpose took occasion to call attention to the instruments by their prospectus, catalogues and otherwise describing what they were and what they would do. In his own prospectus, which was published in 1863 and attached to the apparatus, he said:

Every apparatus consists of two parts, the telephone proper and the receiver. These two parts are placed at such distance from each other that the singing or toning of a musical instrument can be heard in no other way from one station to the other except through the apparatus.

Both parts are connected with each other and with the battery *B*, like common telegraphs. * * * The galvanic current goes * * * through the copper strip to the platinum leaf on the middle of the membrane, then through the foot of the angle to the screw *b*, in whose hollow a small drop of mercury is placed. * *

If now sufficiently strong tones are produced in front of the sound-opening *S*, through the vibrations of the same, the membrane and the angular-shaped little hammer lying upon it are set in vibration; *the circuit is alternately opened and closed at every full vibration* and hereby are produced in the iron rod of the spiral at station *C* the same number of vibrations, and those are perceived there as tone or tone combinations.

Besides the human voice there can be produced (according to my experience) just as well the tone of good organ pipes from F—c and those of the piano.

Albert, the mechanician employed to make the instruments, in his catalogue published in 1866, enumerates among the things he has for sale "the telephone of Reis for reproducing tones by electricity;" and in a work on electricity by Ferguson, published in London and Edinburgh, in 1867, it is said in speaking of the telephone:

This is an instrument for telegraphing notes of the same pitch Any noise producing a single vibration of the air, when repeated regularly a certain number of times a second, not less than 32, produces, as is well known, a musical sound. A person when singing any note causes the air to vibrate so many times per second, the number varying with the pitch of the note he sings. The higher the note the greater the number of vibrations. If we then by any means can get these notes to break a closed circuit, a note sung at one station can be reproduced, at least as far as pitch is concerned, at another. The Reis telephone, invented in 1861, accomplishes this in the following way:

It is needless to quote further from the evidence on this branch of the case. It is not contended that Reis ever succeeded in practically transmitting speech, but only that his instrument was capable of it if he had known how. He did not know how. All his experiments in that direction were failures. With the help of Bell's later discoveries in 1875, we know now why he failed.

As early as 1854 Bourseul, in his communication which has already been referred to, had said substantially that if the vibrations of air produced by the human voice in articulate speech could be reproduced by means of electricity at a distance, the speech itself would be reproduced and heard there. As a means of stimulating inquiry to that end, he called attention to the principle on which the electric telegraph was based, and suggested the application of that principle for such a purpose. He said:

The electric telegraph is based on the following principle: An electric current passing through a metallic wire circulates through a coil around a piece of soft iron, which it converts into a magnet. The moment the current stops, this piece of iron ceases to be a magnet. This magnet takes the name of electro-magnet.

This magnet, the electro-magnet, can thus alternately attract or let go a movable plate, which by its movements back and forth produces the conventional signals used in telegraphy.

Then, after referring to the mode in which speech is transmitted by the vibrations of the air, he said:

Suppose a man speaks near a movable disc sufficiently flexible to lose none of the vibrations of the voice, and that this disc alternately makes and breaks the connection with the battery; and you may have at a distance another disc which may simultaneously execute the same vibrations.

That Reis was working all this time, from the beginning to the end of his experiments, upon the principle of the telegraph as thus suggested by Bourseul, is abundantly proved. In his first paper, after describing his cubical block apparatus, he said:

If now tones or a combination of tones are produced in the neighborhood of the blocks, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate. At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, *and the current traversing the strip remains broken*, until the membrane forced by a new condensation presses the strip (proceeding from *p*) against *d*. In this way *each sound causes a breaking and closing of the current.*

Such was the beginning and it was maintained persistently to the end, as well by Reis as by those who availed themselves of what he was doing. To this the Reis-Legat apparatus forms no exception, for in the paper describing it, Legat says:

The operation of the apparatus described is as follows:

When at rest the galvanic circuit is closed, when the air, which is in the tube *a b* of the apparatus, Fig. 4 A, is alternately condensed and rarefied by speaking into it (or by singing or introducing the tones of an instrument), a movement of a membrane closing the smaller opening of the tube is produced, corresponding to such condensation or rarefaction. The lever *c d* follows the movements of the membrane and opens and closes the galvanic circuit at *d g*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed.

In consequence of this operation, the electro-magnet of the apparatus Fig. 4 B, in accordance with the condensations or rarefactions of the column of air in the tube *a b*, Fig. 4 B, is correspondingly demagnatized and magnetized, and the armature of the magnet is set into vibrations like those of the membrane in the transmitting apparatus.

We have not had our attention called to a single item of evidence which tends in any way to show that Reis, or any one who wrote about him, had in his mind anything else than that the intermittent current caused by the opening and closing of the circuit could be used to do what was wanted. No one seems to have thought that there could be any other way. All recognized the fact that the minor differences in the original vibrations had not been satisfactorily reproduced, but they attributed it to the imperfect mechanism of the apparatus used, rather than to any fault in the principle on which the operation was made to depend.

It was left for Bell to discover that the failure was due not to workmanship, but to the principle which was adopted as the basis of what was to be done. He found that what he called the intermittent current, one caused by alternately opening and closing the circuit, could not be made, under any circumstances, to reproduce the delicate forms of the air vibrations caused by the human voice in articulate speech; but that the true way was to operate on an unbroken current, by increasing and diminishing its intensity. This he called a vibratory or undulatory current, not because the current was supposed to actually take that form, but because that language expressed with sufficient accuracy his idea of a current which was subjected to gradual changes of intensity, exactly analogous to the changes of density in the air occasioned by its vibrations. Such was his discovery, and it was new. Reis never thought of it, and he failed to transmit speech telegraphically. Bell did, and he succeeded. Under such circumstances it is impossible to hold that what Reis did was an anticipation of the discoveries of Bell. To follow Reis is to fail, but to follow Bell is to succeed. The difference between the two is just the difference between failure and success. If Reis had kept on he might have found out the way to succeed; but he stopped and failed. Bell took up the work and carried it on to a successful issue.

OTHER ALLEGED ANTICIPATIONS OF BELL'S METHOD.

As to what is shown to have been written and done by Dr. Van der Weyde, it is only necessary to say that he copied Reis, and it was not until after Bell's success that he found out how to use a Reis instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose.

As to James W. McDonough, we presume it will not be claimed that he is entitled to more than he asked for in his application for a patent, filed in the Patent Office April 10, 1876. There a circuit breaker, so adjusted as to break the connection by the vibration of the membrane, is made one of the elements of his invention. The Patent Office was clearly right in holding him to have been anticipated by Reis.

The patents of Cromwell Fleetwood Varley, of London, England, one dated June 2, 1868, and the other Oct. 8, 1870, were for improvements in the electric telegraph. The objects of the invention covered by the first are to cut off the disturbance arising from earth currents, and to obtain a high speed of signaling in long circuits, and the object of the second was the increase of the transmitting power by enabling more than one operator on a single wire to send more than one message to independent stations. In the specification it is said:

By my invention I superpose upon the currents used for working the ordinary telegraphs rapid undulations or waves which do not practically alter the mechanical or chemical power of the ordinary signal currents, and by new apparatus, hereinafter described, these undulations are made to produce distinct and independent audible or other signals so long as these undulations are produced, whether ordinary signal currents be flowing or not.

In short, there is nothing in any part of the specification to indicate that the patentee had in his mind undulations resulting from gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations, which was Bell's discovery, and on which his art rests. His purpose was to superpose, that is to say, to place upon the ordinary current another, which by the action of the make and break principle of the telegraph, would do the work he wanted.

ALLEGED ANTICIPATION BY DANIEL DRAWBAUGH.

Another alleged anticipation is that of Daniel Drawbaugh. Bell got his patent March 7, 1876, and the fortunate accident which led to his discovery occurred June 2, 1875. Active litigation to enforce the patent rights was begun by his company on the 12th of September, 1878, with a suit in the Circuit Court of the United States for the District of Massachusetts against Peter A. Dowd. This suit was defended by the Western Union Telegraph Company, and vigorously contested. The answer was filed November 4, 1878, setting up alleged anticipation by Gray, Edison, Dolbear and others. The record fills 1,200 printed pages; but before a decision was reached the case was compromised, and a decree entered by consent. The litigation ended some time in the latter part of the year 1879. The last deposition was taken on the 19th of September in that year.

The next contested suit was brought in the same court, on the 28th of July, 1880, against Albert Spencer and others. An answer was filed in this case September 6, 1880, and depositions afterwards taken, some of those in the Dowd suit being used in this by stipulation. On the 27th of June, 1881, a decision was announced by Judge Lowell, sustaining the patent, upon which a decree was entered.

On the 14th of November, 1879, Mr. A. G. Tisdel filed in the Patent Office an application for a patent for a new and useful improvement in speaking telephones. On the 18th of November, 1879, Frank A. Klemm also filed an application for a patent, for a new and useful improvement in telephone transmitters. These inventions were transferred by assignment to Ernest Marks and Frank A. Klemm, of New York City, —— Levy, of Cincinnati, and Simon Wolf, of Washington. On the 6th of March, 1880, these parties entered into a mutual agreement, to the effect that each and all of their interests in said improvements and inventions, and the letters patent to be issued therefor, should be merged and consolidated as the common stock in a corporate body under the laws either of the State of Ohio or New York, or the general laws of the United States, relating to the formation of corporations in the District of Columbia, or in such other States and Territories as might be found necessary hereafter. This agreement was recorded in the Patent Office March 10, 1880.

On the 6th of May, 1880, Edgar W. Chellis, a merchant of Harrisburg, Pennsylvania; H. W. Jacobs, a lawyer of the same place, and Lysander Hill, a lawyer then residing in Washington, in the District of Columbia, made an arrangement with Daniel Drawbaugh, by which they were to become jointly interested with him in his alleged telephone inventions, each to have a quarter interest. Nothing was paid for this, but each of the parties was to have one quarter of anything that should be realized from the enterprise. On the 24th of May, 1880, Simon Wolf, one of the parties interested in the Klemm and Tisdel inventions, visited Harrisburg on business with Chellis in reference to telephone matters. On the 18th of May, six days before this visit, a patent was issued to Wolf and his associates upon the invention of Tisdel. While Wolf was in Harrisburg, negotiations were begun by Chellis for the transfer of the Drawbaugh inventions, and these negotiations resulted in a conditional contract on the 22d of June, by reason of which Chellis, Jacobs, Hill and Drawbaugh went to Washington. There, on the 21st of July, 1880, Drawbaugh, claiming to have invented "new and useful improvements in the transmission of vocal speech, and the apparatus to be used for those purposes, for which I am about to make application for letters patent of the United States" assigned to Klemm, Marx, Wolf and Levy, the full and exclusive right to the said inventions as fully set forth and described "in the specifications prepared and executed by me, dated 21st July, 1880, preparatory to obtaining Letters Patent of the United States therefor." He, at the same time, and by the same instrument, authorized and requested the Commissioner of Patents to issue the patent to his assignees, each as assignee of one-quarter part. The specification referred to in the assignment has not been put in evidence in any of the cases. In the course of taking the testimony, it was called for by the Bell company, but the counsel for the opposite party declined to produce either the original or a copy from the Patent Office. The assignment was recorded in the Patent Office July 22, 1880, and in the official Digest of Assignments, the following notice appears:

About to make application. Specification dated July 21, 1880.

On the morning of July 22, 1880, the following article appeared in the Cincinnati *Commercial*, a newspaper printed at Cincinnati, O.:

TELEPHONE COMBINATION.

Special to the Cincinnati *Commercial*.

WASHINGTON, D. C., July 21.

An application for a patent was filed to-day, that in consequence of its vastness of interest, as well as wealth of prospect, renders it a subject of national interest. A company of leading business men has been formed, that has bought up all the telephone patents antedating those now in use, and known as the Bell, Gray and Edison patents. The company is composed of leading business men from all parts of the country, Cincinnati being largely represented and interested. The cash capital of the company is $5,000,000, with headquarters in New York, and in about 60 days they will open up the telephone, which will certainly result in the driving out of all telephones in the market, save the ones they hold, or else in compelling the Gray, Bell and Edison lines to pay the new company a munificent royalty. It appears from the testimony now on file and in the possession of the new company, which is conclusive and exhaustive, that the inventor of the telephone is a poor mechanic, living near Harrisburg, Pa., named Daniel Drawbaugh. Owing to his poverty, he was unable to push his patent on the market. The new company have secured and are sole possessors of this invention, antedating those now in use. They are also owners of four patents for telephones issued to Mr. Klemm, of New York. A large number of capitalists were here to-day to see the filing of the application, and they assert, with a positiveness that is almost convincing, that it will not be long till they have entire charge of the telephones, not only in this country but in the world, and that they will be able to establish lines by which messages can be transmitted for almost a song.

Mr. Lipman Levy, of the law firm of Moulton, Johnson & Levy, of Cincinnati, was here to-day in the interest of the Cincinnati parties, who, as already stated, are among the most prominent financial men of our city.

Afterwards, on the 23d of August, 1880, the following appeared in the *Journal of Commerce*, a newspaper printed in the city of New York:

A New Telephone Company.—A company has recently been formed in this city, with a capital of $5,000,000, for the purpose of manufacturing telephones. The company is to be known as the People's Telephone Company, and a number of leading capitalists in this city and Cincinnati are interested in it. The telephones are to be manufactured under the patents of Frank A. Klemm and Abner G. Tisdel, and the application for patents of Daniel Drawbaugh, of Eberly's Mills, Cumberland County, Pa., filed July 21, 1880. It is claimed by those interested in the new enterprise that Drawbaugh is really the inventor of the telephone, and had completed one years before Professor Bell or any one else had manufactured one. He was, however, in very humble circumstances, and his neighbors who knew of his experiments looked upon him as a harmless lunatic. He continued improving his original telephone, and it is claimed that the one which the new company proposes to furnish is superior to any now in use. The company has fitted up a factory in Brooklyn, and in three months will be prepared to supply 1,000 of the new telephones. As soon as operations are actively commenced, it is expected

that legal proceedings will be begun against the new company by the Gold and Stock Telegraph Company, which holds most of the existing patents, and a long and interesting legal fight is anticipated.

On the 30th of August, 1880, the People's Telephone Company was incorporated under the general laws of New York, with an authorized capital stock of $5,000,000, for manufacturing, constructing, owning, furnishing, letting and selling telephones and the apparatus used therewith under the inventions and patents of Abner G. Tisdel, Frank A. Klemm, Daniel Drawbaugh, and other inventions and patents which may hereafter be assigned to that company. On the 4th of September, 1880, Klemm, Levy, Marx and Wolf, in consideration of $4,999,550, represented by 99,991 shares of stock, assigned and transferred to that company all their interests in the Klemm, Tisdel and Drawbaugh inventions, those of Drawbaugh being described as "inventions in telephones made by Daniel Drawbaugh, of Eberly's Mills, Cumberland County, Pennsylvania, for which applications for patents were made on or about the 21st of July, 1880, and which were assigned to us on the 31st of July, 1880, as more particularly appears in the deed of assignment, recorded in the United States Patent Office." For the assignment from Drawbaugh to Klemm, Marx, Levy and Wolf, $20,000 was paid in money to Chellis, Jacobs and Hill, and they were allowed to have a certain amount of the stock of the proposed corporation then formed. What amount they actually got, Chellis, who was sworn as a witness in the case, declined to state, but he admitted it was large.

At this time and in this way, the attention of the general public was called, for the first time, to the fact that Drawbaugh claimed to have anticipated Bell in the discovery of the telephone. Bell's success had been proclaimed more than four years before, at the Centennial Exhibition in Philadelphia. In the meantime inventions in aid of his discovery had been multiplied. According to the testimony of Park Benjamin, more than 100 patents had then been issued and indexed under the word "telephone," and numerous interferences had been declared and considered by the Patent Office. Gray, Edison, Dolbear and others had either claimed for themselves, or others had claimed for them, priority of invention and discovery, and Bell had thus far been sustained as against them all. Blake had perfected his microphone apparatus, and Bell's patent had become a great commercial success. The People's company either began or threatened to begin operations under its charter, and on the 20th of October, 1880, the Bell company brought suit against it in the Circuit Court of the United States for the Southern District of New York, to prevent any infringement of the Bell patent. In the bill it was alleged that—

> telephone exchanges now exist in more than 275 towns and cities of the United States, and in every State thereof, and exist in substantially every city having more than 15,000 inhabitants, and in many smaller places. . . . . That there are now in use more than 100,000 electric speaking telephones, licensed by and paying royalty to the Bell company; that the owners of the Bell patents, and those who now are, or heretofore have been, licensees of them, have devoted great time and attention and large sums of money to the development of the telephone and the introduction thereof into extensive use, and to the proper construction of the most suitable telephone lines and systems, and telephonic appliances, and have constructed many thousand miles of telephone lines for use with telephones owned by the Bell Company and licensed by it for such use; and nothing which the defendants, or F. A. Klemm, A. G. Tisdel or Daniel Drawbaugh have done, has contributed in any substantial way to the development of the telephone or the introduction thereof into use.

The bill then avers that Klemm, Marx, Levy and Wolf, having become the owners of these inventions, and having heard that Daniel Drawbaugh claimed that—

> he had made some experiments relating to electric speaking telephones (which experiments, if made, were incomplete, imperfect, unfruitful and long before abandoned), entered into an arrangement with him to set up and claim that he was the first inventor of the electric speaking telephone, and to make application for a patent therefor; and that thereafter alleging and pretending that said Drawbaugh was the original and first inventor of the electric speaking telephone, and that electric speaking telephones had not before such application been in public use or on sale for more than two years with the knowledge and consent of Drawbaugh, did on or about the 21st of July, 1880, induce him to make and cause to be filed in the Patent Office of the United States an application for a patent, to issue to them as the assignees of the said Drawbaugh as the first and original inventor of the electric speaking telephone.

It was then further alleged that if Drawbaugh had ever made his pretended inventions, they had not been by him or any one claiming under him introduced into public use, and "that knowledge thereof has been withheld from your orators and the public, except so far as they have been disclosed within the three months last past by certain newspaper publications."

To this bill the People's company filed an answer in December, 1880, or January, 1881. The record does not show the precise date. In this answer it was said that Drawbaugh was the original and first inventor and discoverer of the art of communicating articulate speech between distant places by voltaic and magneto electricity, and that long prior to the alleged invention by Bell, Gray and Edison, he then and now residing at Eberly's Mills, constructed an apparatus which was a practical working electric speaking telephone, at said Eberly's Mills, and exhibited the same in successful operation to a great number of other persons residing in his vicinity and elsewhere; and that his telephones as then constructed and operated contained all the material and substantial parts and inventions patented in the patents of Bell, and also other important and valuable inventions in electric and magneto telephones, and were actually used for transmitting articulate vocal sounds and speech between distant points by means of electric currents; that he had the original instrument which he used and had exhibited to many others long prior to the said alleged inventions of Bell or either of them; that they are still in existence and capable of successful and practical use, and are identified by a large number of persons who personally witnessed their practical operation and use in the years 1870, 1871, 1872, 1873 and 1874, and several years prior and subsequent thereto; that certainly more than fifty and probably not less than one hundred persons, or even more were cognizant of said Drawbaugh's invention and use of said telephone, and of his claiming to be the original and first inventor thereof prior to the alleged inventions of said Bell or either of them; that said Drawbaugh for more than ten years prior to the year 1880 was miserably poor, in debt, with a large and helpless family dependent upon his daily labor, and was from that cause alone utterly unable to patent his invention or caveat it, or manufacture and introduce it on the market; that said Drawbaugh never abandoned the said invention nor acknowledged the claim of any other person or persons thereto, but always persisted in his claims and intended to patent it as soon as he could procure the necessary means therefor. That said Drawbaugh never acquiesced in the public use of said Bell, Gray, Edison, Blake or other telephones, nor in the claims of the alleged inventors nor gave his consent to such use.

It is then said that Drawbaugh, after finding by experiment that his invention was capable of successful working, conceived that its range and capacity for usefulness to the public might be greatly enlarged, and that many improvements of great value might be made and added to it, which without departing from its principle, might increase its value to himself and to the public; and therefore set himself at work to discover and invent such improvements; that he discovered and invented some such improvements prior to any alleged invention by the said Bell; and then, notwithstanding his embarrassed and impoverished pecuniary condition, and his utter want of proper mechanical tools, materials and appliances to conduct such work, he labored with all reasonable diligence to perfect and adapt his said improvements, and did finally, in due exercise of such reasonable diligence, perfect and adapt the same; and that, in so far as the said Bell has incorporated such improvements in his said two patents, or either of them, he, the said Bell, has surreptitiously and unjustly obtained a patent or patents for that which was in fact first invented by said Drawbaugh, who was using reasonable diligence in perfecting and adapting the same; and therefore, the patent or patents of the said Bell therefor is, or are, invalid and void.

It is then said that—

> the defendants in good faith, and relying upon his legal rights, caused application to be made and filed in the Patent Office for the invention of the said Daniel Drawbaugh, with the intention of procuring interference proceedings to be instituted in accordance with the statute, against the patents of said Bell, and the pending applications of said Gray, Edison and others, in order that said Drawbaugh might be adjudged by the Commissioner of Patents to be the original and first inventor of the electric speaking telephone, and might be adjudged entitled to receive a patent or patents therefor.

The People's Company began taking depositions on the 19th of April, 1881, but Drawbaugh himself did not appear as a witness until Dec. 7, 1881. After that time others were examined, and when the proofs were closed, between three and four hundred witnesses had been produced whose testimony was taken and put into the record to establish the priority of Drawbaugh's invention. This testimony, as is now claimed, shows the story of that invention to have been as follows:

Early conception and experiments with a continuous current, 1862 and 1866 and 1867.
Tea-cup transmitter and receiver, 1866 and 1867.
Tumbler, tea-cup and mustard can F and D, 1867 and 1869.
Improvement on B, namely, C, 1869 and 1870.
Further improvements on C and the more perfect magneto-instrument I, 1870 and 1871.
Mouth-piece changed to centre and adjusting-screw inserted (exhibit A), 1874.
D and E, perfectly adjusted and finished magneto-instruments, January and February, 1875.
L, M, G and O, February, 1875, to August, 1876.
H, August, 1876.
J, N and P, 1878.

This statement of the Drawbaugh claim we have quoted from the brief of counsel appearing in his behalf, and his success in the litigation has been based, as we understand it, both in the answer and in the argument, on the truth or falsehood of what is thus set forth.

The letters F and D, etc., in the statement, refer to exhibits in the case, being certain instruments claimed to have been made and used by Drawbaugh in the progress of his work, and preserved until now. The original teacup instrument was not produced, but Drawbaugh gave in his deposition what he said was a drawing showing how it had been constructed. F, B, C, D, I and A were neither of them in a condition for use when they were put in evidence, and none of the witnesses except Drawbaugh could tell how they were originally constructed, or what the process was by which sound was transmitted when they were used. All that any of the witnesses could say on that subject was that they had used one or more of the different instruments at Drawbaugh's shop, and heard sounds and sometimes words spoken to them, and that Drawbaugh told them the sound was carried on the wire by electricity. There was nothing whatever produced in print or in writing on the subject, nor even a memorandum or drawing of any kind, and there is nothing in the testimony to show that Drawbaugh ever told any one how his earlier instruments were made, or what his process was, until he was called as a witness in December, 1881, and explained it in his testimony. This was nearly twenty years, according to the present claim, after he had begun his experiments, nearly seven years after he had made and used D and G, perfectly adjusted and finished magneto instruments, more than five years after L, M, G, O and H had been constructed and connected in his shop, if his story is true. It was also nearly six years after the date of Bell's patent, more than five years after the success of his discovery had been proclaimed at the Centennial Exhibition in Philadelphia, four years after his invention had gone into public use, three years after it had become an established success, and two years after he had brought the first suit for the establishment of his right against Dowd, who represented the Western Union Telegraph Company, to a successful termination.

THE CONDUCT OF DRAWBAUGH CONSIDERED.

Under these circumstances it becomes important to consider the conduct of Drawbaugh in reference to his alleged invention during his twenty years of eventful history, as connected with the discovery and use of the telephone. If his present claim is true his experiments began almost as far back as those of Reis, and he had in his shop at Eberly's Mills, within three miles of Harrisburg, telephones that were substantially perfect months before Bell (June 2, 1875) got the clue to his subsequent discovery. It is conceded that D and E, claimed to have been made in February, 1875, are substantially as good magneto instruments as any Bell had used before December, 1881; and L, M, G, O and H, all of which were constructed, it is claimed, between February, 1875, and August, 1876, are as good or nearly as good microphones as those of Blake, which were not invented until 1878. This is the theory of Drawbaugh's defense, as set forth in the answer and in the argument, and by it his case must stand or fall.

The claim is that the discovery of the process was complete, and that perfect telephones had been made and were in a condition for actual use a year and more before Bell got his patent.

Drawbaugh was, when he gave his deposition, 54 years of age, and had lived all his life at or near Eberly's Mills, a small village near Harrisburg. He was a skillful and ingenious mechanic, and if he made D and E, and the instruments which came after them at the time it is said he did, he had good tools and good material in 1875 and 1876, and was capable of doing the best of work. He was also somewhat of an inventor, and had some knowledge of electricity. According to the testimony he was an enthusiast on the subject of his talking machine, and and showed it freely to his neighbors and people from the country, whenever they visited his shop.

The Centennial Exhibition was opened in Philadelphia in May, 1876. Drawbaugh visited it on the 17th of October, 1876, remaining four or five days. Before he went he had heard, as he says, that some one besides himself invented a speaking telephone, which he had the impression was on exhibition there. If what he now claims is true, he had then on hand in his shop, exhibits D, E, L, M, G, O, and H, all of them good instruments of their kind and capable of transmitting speech, and some of them but just finished. Bell's apparatus had been exhibited to the Board of Judges in June before, and had attracted marked attention. The matter was much discussed in the public press, and yet it never seems to have occurred to Drawbaugh to take any of his telephones with him when he went, although they were small in size, and some or all of them could have been been carried without serious inconvenience. When giving his testimony he was examined in chief as to that visit, and this is what he said on the subject of telephones:

Q. Did you attend the Centennial Exhibition at Philadelphia in 1876? *Yes, sir; I did.*
Q. Can you give the date on which you went there? *A.* I can by reference to a book. It was October, 1876. The 17th was a day on which I dated a letter from Philadelphia, when I was there on that visit.
Q. How long did your visit there last? *A.* About four or five days, to the best of my recollection.
Q. Who went with you on that visit? *A.* Mr. George Leonard.
Q. Was that the only visit to the Centennial Exhibition that you made? *A.* Yes, sir; it was.
Q. At the same time that you went there, or before that time, had you heard that somebody else besides yourself had invented a speaking telephone or a telephone? *A.* Yes, sir; some time before that. I don't remember how long, but not a great while.
Q. When you went there, did you suppose it would be on exhibition there? *A.* I don't remember whether I had heard that it was on exhibition or not, but I got the impression some way that it was on exhibition.
Q. While you were there at the Centennial did you see any telephones or make an effort to see any there? *A.* Yes, sir; I made an effort and seen an instrument called a telephone and supposed it to be the instrument spoken of; the one of which I had heard. I was looking and had made some inquiry, and was directed or came to a portion of the building where I saw on a counter some man's telephone, the name I don't remember. At that time or several times that I called, there was no one there to attend to it. I spoke to another party that had something else on exhibition, I don't recollect what it was, just near by, and I asked him whether there was any one there to attend or show the instruments. I was informed then there was no one there to show them.
Q. If you remember, please state what kind of an instrument it was that you saw there, and state what information you were able to obtain there regarding it and its mode of operation? *A.* There was a number of instruments placed on to a raised portion, something like a shelf; that is, it resembled something like pigeonholes, a box open in front, and each instrument at the back of it had an electro-magnet. The number of instruments I don't remember. I don't remember of counting them. If I am not mistaken there may have been a dozen or more. Perhaps some were larger than others. I can't give you a much better description than that. I couldn't get any information about them. This attendant made some remarks about the instruments, but he didn't understand them and couldn't explain them. I was several feet from where the instruments were. They were on a raised place like a shelf, just about high enough for a man to speak into. That is the way it looked to me. I didn't go behind the counter to examine them.
Q. Did you see any circulars lying around there referring to these instruments or any advertisements of them? *A.* I don't remember about that. It may have been.
Q. What was your impression as to the character of the instruments when you finally left them? *A.* I was impressed with the idea that they were instruments to telegraph by sounds, a certain sound to represent a certain letter of the alphabet. I am not certain how I got the idea, or whether any person told me that at the time, but that is the idea that I had.
Q. Do you know whether that was Gray's harmonic telegraph that you saw there or not? *A.* It didn't say "telegraph." I am confident it was called telephone. I didn't see the working parts of the interior except the electro-magnets. I took the name of the man and his address on a piece of paper and put it in my pocket, but I don't know what became of it. I don't know whether it was Gray's harmonic telegraph or not.
Q. Did you see any tuning-forks about it? *A.* I did not.

That was all he did during his entire visit to ascertain whether any one besides himself had actually entered upon this new and interesting field of invention and discovery. He spoke to no one about what he had done himself. He made no special effort to find out whether that which was on exhibition was in any respect like what he had at home; neither did he when he got home, as far as the record shows, say anything to his neighbors or visiting friends about what he had seen or heard. He had apparently lost all interest in talking machines.

Not so, however, with his other inventions. The testimony shows that during the early part of 1876 he was much occupied in building an electric clock which he thought of exhibiting at the Centennial. This he did not do, however, but several days before he went to Philadelphia, or soon after, Rufus E. Shapley, a jeweler of Mechanicsburg, went on his suggestion to Eberly's Mills to look at the clock which he had made. Soon after that the clock was taken to Shapley's store in Mechanicsburg, and on the 8th of November, 1876, Drawbaugh, by an instrument in writing, transferred to Shapley a one-half interest "In the clock I am getting up, the said Shapley to pay for patenting the same." Shapley had then $2,000 in money, which Drawbaugh was anxious to have him invest in this business. The clock was taken by him to his shop so that it might be examined with that end in view, if it should prove to be useful. Some time afterwards it was taken back to Eberly's Mills, where it remained until April 1, 1878, or thereabouts, when a clock company was formed, and this clock, or another one substantially like it, was taken about the country for exhibition. For this, Drawbaugh was paid $500 and an interest in the profits.

On the 20th of September, 1878, he applied for a patent for improvements in batteries for electrical clocks. The patent was issued January 14, 1879, to the members of

that clock company. The enterprise does not seem to have been productive of any very great success.

In November or December, 1878, while this clock was on exhibition, Drawbaugh was introduced to Edgar W. Chellis. He had with him at the time a wooden model of a faucet that he wanted Chellis and another man to take a one-third interest in. An arrangement was made by which Chellis got a two-thirds interest, he paying $250 for it January 7, 1879. On the 14th of the same month, Drawbaugh filed in the Patent Office an application for an improvement in rotary measuring faucets. After this application an interference was declared, March 27, 1879, between Drawbaugh and David A. Hauck, who had filed an application. In his preliminary statement in this interference, Drawbaugh said he had conceived the idea of his faucet in the fall of 1869, and made a working model in 1877, and the Patent Office model was not completed until about the 1st of November, 1878. The case was closely contested and finally decided in favor of Drawbaugh, January 15, 1880. The patent was granted to him and Chellis July 6 of the same year. In this contest, Jacobs and Hill, who afterwards became interested in the telephone claim, appeared as the counsel for Drawbaugh.

On the 2d of July, 1879, Drawbaugh filed another application in the Patent Office for an improvement in water motors. Chellis was to have in this also a two-third interest. On this application a patent was issued March 16, 1880.

DRAWBAUGH'S CONDUCT INCONSISTENT WITH HIS CLAIMS.

It is impossible to believe that if Drawbaugh had in his shop, when he reached home from the Centennial, exhibits D, E, L, M, G, O and H, or even D and E alone, that he would have set himself to work in the first instance in developing the clock enterprise or perfecting his former conception of the measuring faucet, instead of calling attention to his great discovery of the telephone, which he was in danger of losing by a patent which had been issued to another, and which he could not but have known was even then attracting the greatest attention. In this connection it must be kept in mind that the theory of the defense, as stated in their answer, is that Drawbaugh had at that time fully perfected his invention, and that while at first "he conceived that its range and capacity for usefulness to the public might be very greatly enlarged," he had before the date of Bell's patent, "notwithstanding his impoverished and embarrassed pecuniary condition and his utter want of mechanical tools," finally perfected his work. His conduct, therefore, is to be judged, not as of one who was still in the midst of his experiments and doubtful as to the results, but of as one who had arrived at the end, and completed his success. No man of his intelligence, with or without the enthusiasm on the subject which it is said he possessed, could remain silent under such circumstances.

As we have read the testimony, it is not even pretended that he took any of these instruments outside of his own village until May, 1878, when, as is claimed, he showed one to his friend Stees, in Harrisburg, whom he had known for years, who was the first to use, and in fact was then using, a Bell telephone upon a private line of his own between his office and his shops. This produced no results; and when afterward, in January, 1879, Chellis was told that Drawbaugh had a phonograph and a telephone that he had invented, he gave it no attention, because, to use his own language, "I was interested in the faucet and motor business and wished to push them, and I did not think we could do much with a telephone, as Bell had a patent and I did not know that he could antedate it."

Again, when speaking of a conversation he had with Drawbaugh, he said, "I advised him to drop the telephone, as he could not antedate Bell. He said he didn't know about that; that he had been working on it a good while. It was his way of expressing himself when I would say "You can't antedate Bell." He would say, "I don't know about that; I have been working at it a good while."

This, it must be remembered, was in 1879, after the telephone had become a success, and after it had been a year or more in use in Harrisburg, where Chellis lived. It is impossible to believe that either Chellis or Drawbaugh was ignorant of the approximate time of Bell's invention, which had been the subject of frequent newspaper comment from the time of its exhibition at the Centennial. The subject was often referred to in the Harrisburg and Mechanicsburg papers, and it is not for a moment to be supposed that all these various articles escaped their attention. Under such circumstances, if it were true that Drawbaugh had made his D and E as is now claimed, in February, 1875, he certainly would have said so, and he would not have contented himself with so doubting an answer to Chellis' suggestion of his inability to antedate Bell, as that which Chellis now says he gave.

Another important fact in this connection is one which is proved by the testimony of Andrew R. Keifer, who, from 1863, had been division telegraph operator having charge of the middle division of the Pennsylvania Railroad, and resided in Harrisburg from 1863 to the winter of 1881. He was a member of an electric firm in that place, engaged in the manufacture of burglar alarms, instruments for the signal bureau, etc. He had also since 1876 kept a place for the sale of electrical supplies. He had known Drawbaugh since 1876, and probably before. Drawbaugh met him on different occasions in the course of their acquaintance and talked with him on electrical matters. In the course of their acquaintance, Drawbaugh showed him an electrical fire-alarm apparatus and the working of his electrical clock, but the subject of telephone was never alluded to between them until the summer of 1881, when this occurred (we quote from the deposition of Keifer):

> In the summer of 1881 I took my wife out for a drive and went over to see his works, never having seen them, and having promised him to come and see him sometime; my wife not caring about going to the shop remained in the carriage, and I went through alone with Mr. Drawbaugh. He showed me through the shops and introduced me to Mr. Chellis, and showed me parts of the water-motor and some other things of his getting up On account of my wife being in the carriage alone I did not stay long. As I stepped into, or was just in the carriage, Mr. Drawbaugh said: "I forgot to show you my telephone! I did not get out to go and see it, and I drove away without seeing it, expecting to see it again, but I have never got over to the shop since.

This was after the suit of the Bell company against the People's company was begun, and of course after the matter got into the hands of Chellis and his associates. It is no answer to the criticism of Drawbaugh's conduct in this particular to say, as was said in the argument, that one reason why he did not speak or apply to every man with whom he had a personal acquaintance was that he was ridiculed by his neighbors; that his invention was considered a humbug by them and of no commercial value. Bell's success was proclaimed in the Harrisburg *Patriot* as early as February 26, 1877, and the age of ridicule was then past. If Drawbaugh had at that time in his shop the machines it is now claimed were there, complete as they now are, in August, 1876, and most of them before, there cannot be a doubt that he would have taken them to some place where they could be tried, and show that they would do what he had all along claimed for them. All he had to do at any time after he came back from the Centennial was to take any pair of his little instruments to his friends at Harrisburg, attach them to a line wire and show what he had. They were men who could appreciate the telephone and help him, if it was, as he now says it was, a success. It would certainly have been easier then, within two years of the time the first of them was made, and within a year of the date of Bell's patent, to show that he antedated Bell, than it was three years afterwards when he was brought into the controversy through the instrumentality of his associates, not, as must be evident to all, to get a patent for himself, but to defeat that of Bell.

In this connection it is specially significant that the application which it was claimed was made for a patent on the 21st of July, 1880, and the specification of his invention which was then written out, has been purposely and designedly kept out of the case, although their production was demanded. They were written before this suit was begun, and it is impossible to believe that they would have been withheld, at least upon the call of the opposite party, if they were in all respects consistent with the subsequent development of the case. The excuse given by counsel at the time, that they were in the secret archives of the Patent Office, and if produced and published in this case would possibly invite the filing of contesting applications and result in an interference and additional litigation, besides unnecessarily prolonging the taking of testimony and increasing the expenses, we cannot accept as satisfactory, in view of the fact that in the answer it was said that one object of filing the application "was to procure interference proceedings to be instituted against the patent of Bell, in order that Drawbaugh might be adjudged by the Commissioner to be, as he rightfully is, the original and first inventor."

We have not overlooked the depositions that have been taken in such large numbers to show that Drawbaugh was successful with F, B, C, I and A, before D and E were made. They have been studied with care, and if they constitute all the testimony in the case it would be more difficult to reach the conclusion that Drawbaugh's claim is not maintained. But in our opinion their effect has been completely overcome by the conduct of Drawbaugh, about which there is no dispute. From the time of his visit to the Centennial until he was put forward by the promoters of the People's company, nearly four years afterward, to contest the claim of Bell, he was silent, so far as the general public were concerned; while if he had really done what these witnesses say he did, he would certainly have spoken. There is hardly a single act of his connected with his present claim, from the time he heard, before going to Philadelphia, that some one else had invented a telephone which was on exhibition at the Centennial, that is not entirely inconsistent with the idea of a complete discovery or invention by himself which could be put to any practical use.

It is not pretended that what he did was done in private. He had influential friends, with ample pecuniary resources to help him in bringing out his inventions when they promised success. He easily got aid for his clock and for his faucet The news of Bell's invention spread rapidly, and it took but a few months to demonstrate to the whole world that he had achieved a brilliant success. No one can believe that the public would be kept in ignorance of the invention until four years afterwards, when a special despatch from Washington to the Cincinnati *Commercial* announced a telephone combination to have entire charge of the telephone in this country.

DRAWBAUGH FAILS TO REPRODUCE HIS ALLEGED RESULTS.

But there is another fact in this case equally striking. As has already been seen, F, D, C, and I were in no condition for use when they were produced and put in evidence. They were mere remains. No one but Drawbaugh himself could state how they were made or how they were to be used. He undertook to reproduce some of them, especially F and G. This was in the latter part of 1881, while the testimony was being taken. The Bell company proposed that they should be tried, to see if they would do what the witnesses said had been done with the originals, which the remains show must have been exceedingly primitive in their character. The testimony also shows that when they were originally used, by or in the presence of the witnesses, no particular care was taken in their adjustment. They were lying around in the shop or placed upon shelves. Some say that when the experiments were made they were held in the hands or allowed to stand on a table. In order to reach satisfactory results Drawbaugh himself said in his deposition:

> I had persons in the cellar reading printed matter, some advertisement or something, and I could hear the words that were read; and at other times I would go down into the cellar and read something and come up, and they would repeat the words to me that I had read.

The proposition of the Bell company was accepted, and the reproductions were tried in March, 1882, under the most favorable circumstances. It is substantially conceded that the trial was a failure. Occasionally a sound was heard and sometimes a word, but it would not transmit sentences. At the time of these experiments, F, which was the transmitter, was placed on a table as Drawbaugh said it was originally.

Two years afterward other productions were presented, differently constructed and used in a different way. Those would talk, but they were neither the same nor used in the same way as the originals. To our minds, the result of the experiment conclusively shows that the original instrument could not have been of a construction similar to the reproductions, and that what they had done was produced by some other means.

We do not doubt that Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity, and have experimented upon that subject. But to hold that he discovered the art of doing it before Bell did, would be to construe testimony without regard to the ordinary laws that govern human conduct. Without pursuing the subject further we decide that the Drawbaugh defense has not been made out.

THE ALLEGED FRAUD IN THE PATENT OFFICE.

Another objection to Bell's patents put forth in the oral argument of Mr. Hill, and in the printed brief signed by him, and in that signed by Mr. Dixon is, that the application as originally filed in the Patent Office did not contain his present fourth claim or any description of the variable resistance method, and that all which now appears in the specification on that subject, including the fourth claim, was surreptitiously interpolated afterwards. Bell's application was filed February 14, 1876, and afterwards, during the same day, Elisha Gray filed a caveat in which he claimed as his invention "the art of the transmission of vocal or other sounds or conversation telegraphically, through an electric circuit," and in his specification described the variable resistance method. The precise charge now made in the printed brief of Mr. Hill is—

> That Mr. Bells attorney's had an underground railroad in operation between their office and Examiner Wilber's room in the Patent Office, by which they were enabled to have unlawful and guilty knowledge of Gray's papers, as soon as they were filed in the Patent Office: and that an important invention and a claim therefor were 'bodily interpolated into Bell's specification between Feb. 14, 1876, and Feb. 19, 1876, by Pollok, in consequence of the guilty knowledge which the latter already had of the contents of Gray's caveat before the declaration of interference with Gray on Feb. 19.

So grave a charge, made in so formal a manner, is entitled to consideration. It involves the professional integrity and moral character of eminent attorneys, and requires us to find from the evidence, that after Bell swore to his application on the 20th of January, 1876, and after the application thus sworn to had been formally filed in the Patent Office, an examiner who got knowledge of the Gray caveat, put in afterwards, disclosed its contents to Bell's attorneys, and they were then allowed to withdraw the application, change it so as to include Gray's variable resistance method, over Bell's signature and over the jurat, and then to restore it to the files thus materially altered, as if it were the original, and all this between Feb. 14 and Feb. 19. Although much stress was laid in the argument on the fact that what purported to be a certified copy of the specification of Bell, as found in the file-wrapper and contents printed in the Dowd case, differed materially from the patent, the occasion of these differences has been explained in the most satisfactory manner.

We entertain no doubt whatever that the specification as now found in the patent is precisely the same as that on which the order to issue was made. If any alterations were made they were all done before Feb. 19, and the fair copy which is now found on the files of the office is precisely as it was when the order for the patent was granted; not a shadow of suspicion can rest on any one.

All that remains, therefore, on which to rest this serious charge, is that in a paper handed by Bell to George Brown, of Toronto, describing his invention, and which was intended to be used in England to secure a British patent, there is now claimed to be an interpolation which in the American application is not to be found. It is but right to say that during the whole course of the protracted litigation about the Bell patent, no argument was ever presented based on this discrepancy until the brief of Mr. Hill was filed in this court on the 18th of January, 1887, six days before the argument on these appeals was begun. So far as we are advised nothing has ever before occurred in the cases that seemed to make it necessary to prove when the variable resistance method, or the fourth claim, was put into the American application, or why it was left out of the paper handed to Brown. It seems always to have been assumed, until the cases got here, that because it was in the American patent it was rightfully there. Certainly there is nothing in the pleadings in any of the cases to direct attention to the materiality of this fact. A comparison of the paper handed to Brown with the American application shows that they differ in more than thirty different places, besides those which relate to the variable resistance method and the fourth claim. The differences are generally in forms of expression, this indicating that one was written after the other, and evidently for the purpose of securing greater accuracy. The paper handed Brown was merely a rough draft and not a fair copy, for the record shows that it bears on its face the evidence of numerous erasures and interlineations. Bell says in his testimony that he began writing this specification in October, 1875, and wrote and rewrote it a number of times, and finally adopted that mode of expression which seemed to him best to explain the invention and the relation which one portion bore to another. He visited Brown in Canada in September and again in December 1875. An arrangement was made between them on the 29th of December, at the last interview, by which Brown was to interest himself in getting out the British patent. Other inventions besides the telephone were included in the contract entered into for that purpose. Bell returned to Boston on the first of January, and immediately set himself to work to complete his specification. It was taken to Washington by Mr. Hubbard, about the 10th of that month, and delivered to Pollok & Bailey, his attorneys. It was then examined by his attorneys and found correct, and a fair copy made, and then returned on the 18th to Bell for his signature. It was signed and sworn to in Suffolk County, on January 20, and immediately returned to the attorneys. Afterwards Mr. Pollok met Bell in New York, and it was again gone over with care by the two together. No change whatever was made in it at that time and Mr. Pollok took it back with him to Washington.

On the 25th of January, 1876, Bell met Brown, who was then on his way to England, in New York. It is now assumed that the papers which Brown took to England were handed to him then; and because the variable resistance method in the fourth claim was not in it, it is argued that it could not have been in the American specification at that time. But no one has said when the paper was actually handed to Brown. Bell says he cannot tell, but it must have been after he made his contract with Brown on the 29th of December. As the American specification was signed and sworn to five days before the interview with Brown on the 25th of January, and the paper of Brown differs from it in so many particulars besides that now in question, it would seem to be clear that the paper was a copy of some former draft that Bell had made and possibly taken to Canada in December, and not that which was perfected afterwards. As the specification which had been prepared and sworn to was a fair copy without erasure or interlineation, the fact that the paper handed to Brown was not a fair copy

would imply that it was not intended to be an exact transcript of the other.

At any rate, the bare fact that the differences exist under such circumstances is not sufficient to brand Bell and his attorneys and the officers of the Patent Office with that infamy which the charges made against them involves. We therefore have no hesitation in rejecting the argument. The variable resistance method is introduced only as showing another mode of creating electrical undulations, and that Bell had had his mind upon such a method is conclusively established by a letter which he addressed to Mr. Hubbard on the 4th of May, 1875, and which is in the Dowd record, introduced into the Overland record by stipulation. Its insertion in his final draft of his specification is another proof of the care with which the work had been done.

INCORPORATION OF THE BELL COMPANY.

In the case of the Clay Commercial Company objection was made to the sufficiency of the proof of the incorporation of the American Bell Telephone Company. The first point is as to the act incorporating the American Bell Company, which authorized certain persons therein named to form a corporation: and second the certificate of the Secretary of the Commonwealth, in the form required by Section 111, Chapter 224, that certain persons, among whom were the members of this company, under the name of the American Bell Telephone Company, were legally organized. This section made such a certificate conclusive evidence of the existence of a corporation organized under that act. The authority granted by the special act to the persons named to organize as a corporation in this way, gave them the authority to select a corporate name, and also made the statutory certificate conclusive evidence. The objections to the proof of title are not, in our opinion, well taken. We do not think it necessary to add to the length of this opinion by referring to the testimony upon that point.

THE SECOND BELL PATENT.

This disposes of all the cases so far as the patent of March 7, 1876, is concerned. It remains now to consider only the other patent. It received but little attention by counsel or court in either of the cases below. In the Dolbear case it was by consent excluded from the decree.

In the case of the Clay Commercial Company it was alleged in the answer that substantial and material parts of the things described and claimed were described and claimed in a prior British patent taken out December 9, 1876, and inasmuch as the foreign patent does not bear the same date, if the American patent is not limited it is void. This point has not been pressed in the argument. In our opinion it has been settled by the decisions of this court in *O'Reilly* v. *Morse* and in *Siemens* v. *Sellers* at the present term, that the effect is not to render it invalid if it is for the same invention, but only to limit its term. The patent in itself is for the mechanical structure of an electric telephone, to be used with the electrical action on which the first patent rests. The *third* claim is for the use, in such instrument, of a diaphragm made of a plate of iron or steel, or other material capable of inductive action; the *fifth* is for a permanent magnet; the *sixth* for a sounding box; the *seventh* for a speaking or hearing tube, and the *eighth* for a permanent magnet and plate combined. The claim is not for these several things, but for an electrical telephone in the construction of which those things or any of them are used. Hence the fifth claim is not anticipated as was decided in the Molecular case below. The patent is not for a magnet, but for a telephone of which it forms a part. To that extent the decree in that case was erroneous.

THE DECREE.

It follows that the decree in each of the cases so far as it is in favor of the Bell Company and those claiming under it, must be affirmed, and that the decree in the Molecular case so far as it is against that company on the fifth claim of the patent must be reversed, and a decree directed to that extent in its favor. It is accordingly so ordered.

Mr. Justice Gray was not present at the argument and took no part in the decision of these cases.

JUSTICES BRADLEY, FIELD AND HARLAN DISSENT.

[At the conclusion of the reading of the opinion of the Court, Mr. Justice Bradley made the following remarks.]

Mr. Justice BRADLEY—Mr. Justice Field, Mr. Justice Harlan and myself are not able to concur with the other members of the Court in the result which has been reached. The point on which we dissent is the question of Drawbaugh's invention. We think that Drawbaugh did anticipate the invention of Mr. Bell. We think that the evidence to that point is so overwhelming, both with regard to the number and character of the witnesses, that it cannot be overcome. Of course, it is a question of fact depending upon the weight of the evidence, and involves no question of law, and therefore it is a matter that does not require much observation on the part of those who dissent from the opinion, which is very ably drawn, and undoubtedly presents the whole case with great force. But on this point we cannot concur in the views of the court. We think that Drawbaugh did have an instrument in his shop as early as 1869, which used the variable resistance instrumentality in transmitting articulate speech to a distance, by means of electricity, and was distinctly heard and understood. That is the whole invention, so far as variable resistance is concerned.

We also think that as early as 1871, he did produce an instrument employing the magneto-electric instrumentality altogether, substantially the same as that which is claimed in Mr. Bell's patent. In the one case, with regard to the variable resistance principle, over 70 witnesses were produced. The evidence of some of them may have been shaken with regard to the time that they had in mind; but the evidence of the great majority of them is not shaken at all. They were mostly plain people of the country, but they heard the words, and that is a matter that they could not be mistaken about. It did not require science nor literature nor refinement to understand that.

In regard to the other instrument, some 40 or 50 witnesses were produced who saw it. Many of them heard the language produced through it, and a number of witnesses who did not hear the language produced through these instruments, saw them or heard them talked about, so as to fix the time that they were in existence, and it seems to us that on this subject of time and of result, there is such a cloud of witnesses that it is impossible not to give credence to them. There is no doubt that Mr. Bell's merits are very great in appreciating the importance of the discovery, and in bringing it before the public in such a manner as to make it appear to be what it is, one of the most important discoveries of the century. He was a man whose professional experience and whose scientific attainments enabled him to see at a glance the importance of it. Drawbaugh was a different sort of man. He did not see it. Had he done so, he would have taken measures to interest persons with him in it, and have brought it out. He was a mechanic, a plain mechanic, somewhat better instructed, perhaps, than most ordinary mechanics, a man of more reading, a man of more intelligence. But he looked upon what he made more as a curiosity than a matter of speculation, a matter of financial importance or of importance to the public. That is the way we view his condition of mind in regard to it, and explain why he had not taken more pains to bring it forward to the notice of the public. It is the tendency of the human mind to attach importance to the results and inventions of those who have achieved eminence. Watt was the idol of the British nation, from the time of his first invention of the steam-engine until the day of his death, and until the present time; and everything that was invented about the steam-engine was attributed to him. It was the glory of England, the glory of Watt, and of course every patriotic British subject would hoot at anything it was claimed Watt did not invent, or attribute it to him. That is a principle of the human mind on which we think a great deal may be explained with regard to the feeling towards this important service which Mr. Bell has rendered with regard to this invention. The plain mechanic of Pennsylvania is of no account. The scientific and illustrious—for he is illustrious—Mr. Bell, it cannot be but that he did invent this thing! And yet if Mr. Bell on the 14th day of January (I think it was) or February, when he applied for his patent at the Patent Office, had had in his laboratory the things that Drawbaugh had, he would have been filled with an excitement far exceeding that which has animated the great inventors of the world when they made the discoveries they have made, and he would have exclaimed, "Eureka! Eureka!" He would have appreciated it, if Drawbaugh did not.

What had he when he applied for his patent? On the 10th of June, 1875, they thought they heard something, but were not sure; but he knew the principle and he patented it. Up to the time of making his application for a patent they had not succeeded in producing intelligible speech, more than a word or two; perhaps a word or two. If Bell had done at that time as much as Drawbaugh had done, according to the evidence, he would have had no hesitation in claiming the greatest discovery that the world has seen in the present century.

This is an outline of the views which we have on this subject. We have nothing to say depreciatory of Mr. Bell at all, for he has real merits, but we think that this obscure mechanic did do the thing, and that he is entitled to the merit of being the first inventor.

We will take an opportunity within a few days to write a further statement and file it.

A New Coupling for Joining Wires.

The annoyances, failures and even fires, which arise from improperly joined wires are so well known among those who have the care of lines and circuits, that much

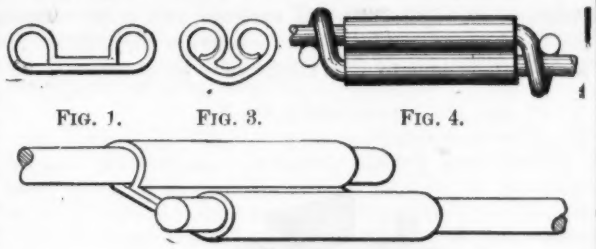


FIG. 1. FIG. 3. FIG. 4.

FIG. 2.

A NEW COUPLING FOR JOINING WIRES.

time and attention has been given to devising suitable splices and enforcing their use by strict rules. Notwithstanding these rules, very bad splices are still frequently found. We believe it is generally acknowledged that a strong soldered joint is the best for good contact, strength and durability, but it is unfortunately still the exception, at least in this country, which is due no doubt to the expense and to the unreliability of such a joint when not properly soldered. The direction of the inventions in this line has therefore been to devise a mechanical splice which comes as near as possible to a well soldered joint.

Among the latest devices for coupling, just patented, is the so-called "vise-grip" coupling, shown in Figs. 1 and 2, in which the aim of the inventor, Mr. Carl Hering, has been to get a grip similar to that of a vise on a large surface of the wire, without the use of screws or other devices, which may in time become loose. The coupling consists of two split tubes, or expansion tubes, which are connected at their edges, as seen in the figures, and which fit the wires loosely. After the wires have been inserted, the mere act of bending the connecting pieces, which is readily done with a hammer blow or a pair of pliers, which every lineman carries, tends to close the two tubes around the wires, as seen in Fig. 3, thus taking a powerful grip around the whole surface of the same. This gripping action is due to the fact that one of the connecting pieces, on being bent, forces itself with considerable power into the two tubes, thus closing them around the wires. Owing to the shape of the coupling before it is applied, this bend will necessarily always be where it is required.

Among the advantages claimed are, that the surface of good contact is very large, being for a No. 4 wire about sixty times the cross section of the wire; that it is mechanically strong, resisting a great tensile strain, and not being loosened by bending; that there are no parts, such as screws, keys, etc., to become loose, which might release grip. Being made of the same material as the wires the there is no electrolytic action tending to corrode the joint, and as its application requires but a short time, there is a saving of time when many splices have to be made in a hurry, as, for instance, after a blizzard. As its application is so simple, too, it does not require skilled linemen to use it; it does not require severely conscientious workmanship to apply it, as in the case of a good twisted joint, or a reliable soldered joint; it can be used equally well for very heavy incandescent leads, and for light telephone wires; although almost equivalent in effect to a soldered joint it is cheaper than most of the ordinary unsoldered splices now used.

Fig. 4 shows how the coupling may, if desired, be secured still more by twisting the short end of each wire around the other.

Opinions on the Telephone Decision.

As might be expected, the great telephone decision rendered at Washington last week has called forth a variety of opinions in interviews, etc., but in very few of them is there anything new or startling. One or two may be quoted. Gen. Bradley T. Johnson, counsel for the Washington Telephone Company, says: "The decision does not definitely sustain the validity of Bell's patent. There is another suit brought by the United States in Boston, to vacate Bell's patent, on the ground that it was fraudulently obtained. This case is now on appeal in the Supreme Court of the United States. In the cases just decided the Supreme Court held, as reported in the morning papers, that Bell was the first inventor. This was held by four judges, while three dissented. The court is composed of nine judges. Justice Gray will not sit in any Bell telephone case. So the United States case will be heard by eight judges. If the new judge, Lamar, sides with the three dissenting judges the court will stand four to four. Several of the justices who have just decided in favor of Bell must retire in a short time and new judges will take their places. Therefore, if any one of the new judges sides with those already on the bench, who have supported Bell's claim as first inventor, his patent will not be set aside. Hence I say this decision is not conclusive, but in the hearing of the pending suit of the United States it may be reversed and Bell's patent set aside."

With regard to the change in the complexion of affairs caused by the sudden death of Chief-Justice Waite, shortly after the decision was rendered, Gen. Benj. F. Butler said: "Justice Lamar's position with regard to this matter may be of the utmost importance. Justice Gray is not eligible to sit in these telephone cases in consequence of his indirect interest in the Bell patent. Justice Lamar was not appointed until after the testimony had all been taken, and therefore did not take any part in the recent decision. Hence the vote stood 4 to 3. The death of Chief-Justice Waite leaves the Court a tie on the question of the validity of the Bell patents, but in the event that it should be decided to grant a rehearing or a review of the case, Justice Lamar would probably then sit with his colleagues in judgment. This possibility makes the problem as to the leaning of the Justice very important to those interested in the Bell telephone. I do not consider the stock has dropped on a mere consideration of the possibilities involved."

Solicitor-General Jenks, who has prosecuted what is known as the "Government case" against the Bell people, seeking to invalidate their patents, said to-night: "Speaking without reference to the merits of the telephone case, I would say that while I do not consider it probable that the Supreme Court will grant a rehearing it is yet within the possibilities. In the first place it is hardly likely that Justice Lamar would rule upon the question as to whether a hearing should be granted. He did not sit in the case and might not consider himself competent to decide whether any good grounds exist for a new trial. In that event the Court would still stand three to three on the application for a rehearing, the petition, therefore failing. If, however, a new trial should be granted Justice Lamar would doubtless cast the deciding vote."

The Schanschieff Primary Battery.

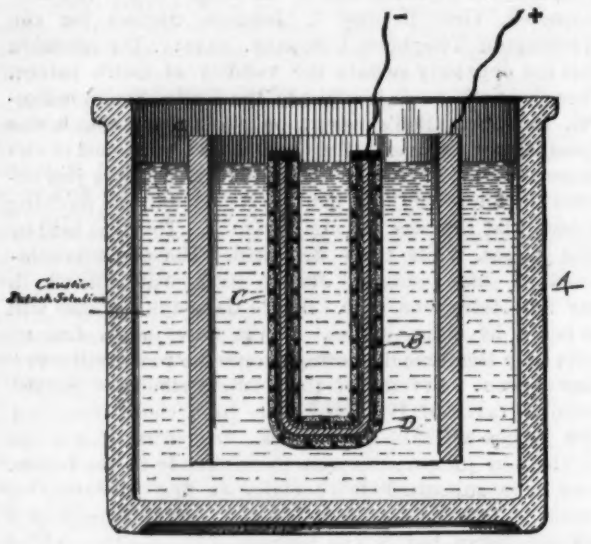
Considerable attention has recently been drawn in England to the primary battery invented by Mr. Alexander Schanschieff, and the battery has just been patented in this country. The electrodes employed are the usual carbon and zinc, but the solution is a mercurial sulphuric acid compound, which is prepared as follows:

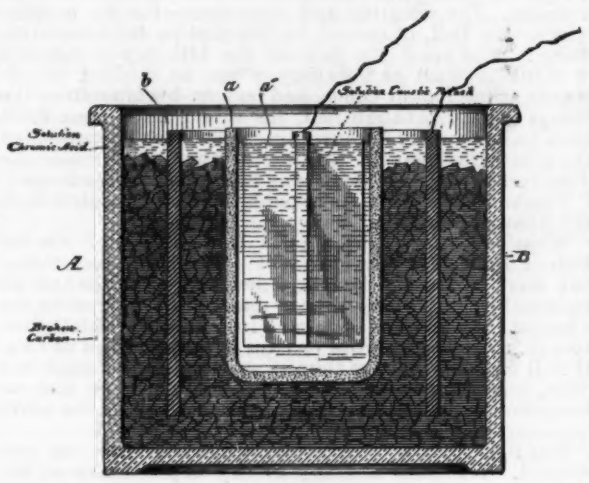
To three pounds of sulphuric acid, specific gravity 1.846, there is added two pounds of metallic mercury. This is boiled until the metal is converted into mercuric sulphate, and the heat maintained until the excess of acid is evaporated and the salt is dry. When cold, one gallon (ten pounds) of water is added. This dissolves a part only, precipitation of basic sulphate of mercury taking place. The solid residue is separated, and this is then again boiled with sulphuric acid, as before, in the proportion of two parts of the residue to three parts of acid. By boiling, the residue is dissolved, and by continuing the heat the excess of acid is evaporated. The resulting mass, when cold, is added to the original solution, and again there is dissolved as much as the solution will take up, and the residue separated. After three or four repetitions the whole is dissolved in the orig-

inal gallon of water. The density of the liquid will then be about 1.425 Baumé and the quantity about five quarts. Finally the liquid is evaporated by heat until the electro-salt is deposited in a solid crystalline state. This is raked out as it falls and packed in closely-stoppered bottles, in which it may be kept for an indefinite time. The salt thus produced consists of a combination of yellow basic sulphate of mercury (known as "turbeth mineral") with bisulphate of mercury, the formula being $2HgO,SO_4 + HgSO_4 + 3H_2O$. The solution of this salt is of higher specific gravity than any mercurial salt heretofore produced. When liquid is required for use in a battery, five pounds of the salt are dissolved in one gallon of water.

A Novel Form of Primary Battery.

In a battery recently invented by Mr. Henry Woodward advantage is taken of the depolarizing property of the oxide of copper in the construction of a cell which shall retain its E. M. F. constant. The cell, which is shown in the accompanying engraving, Fig. 1, has a negative element of peculiar construction and the positive electrode is constructed of zinc sponge. The negative element *B* is made by taking a piece of iron of requisite size and shape, placing around it a jacket *C* of perforated iron, and filling the space between the casing and the piece of iron with oxide of copper and iron filings, or turnings *D*. By this construction a large and good conducting surface is secured, while rapid polarization is prevented. The electrode is placed in a caustic-potash solution in a cell with the zinc sponge element.





FIGS. 1 AND 2.—THE WOODWARD PRIMARY BATTERY.

In another form of cell designed by Mr. Woodward, the object has been to obtain a battery of high E. M. F., and which shall at the same time be of low cost. This cell, which is shown in Fig. 2, consists of an outer jar *A*, in the centre of which is placed a porous cup *a*, containing a series of zinc plates *a'*, these plates being connected together in order to present as large a surface as pssible. In this cup is placed a solution of sea-salt, Epsom salt or caustic potash, the latter, however, being most efficient.

To make the caustic-potash solution, a sufficient quantity of crude potash is boiled in water until the water is thoroughly saturated, which requires about three hours, when there is added a paste made of lime, and the whole is then boiled for about two hours longer, after which it is strained. It is then ready for use. The outer jar *B* is filled with broken pieces of carbon, in which is placed a carbon plate *b*. Upon this carbon plate is poured a strong solution of chromic acid.

This combination, it is claimed, yields a comparatively high electromotive force.

State Taxes on Telegraph Companies.

A decision was rendered by the Supreme Court at Washington on March 19 in the case of the Western Union Telegraph Company against the Attorney-General of Massachusetts. This was a suit to enforce the collection of a tax levied by the authorities of the State upon the telegraph company and for the purpose of enjoining that company from the further operation of its telegraph lines within the limits of the State until the tax should be paid. The telegraph company refused to pay the tax upon the ground that out of its 2,833 miles of line within the State of Massachusetts, more than 2,334 miles were over, under, or across post roads, made such by the United States, leaving only 498 miles not over or along such post roads, on which the company offered to pay the proportion of the tax assessed according to mileage by the State authorities. The company asserted that it had filed with the Postmaster-General a notification of its acceptance of the provisions of the law contained in sections 5,263 to 5,269, Revised Statutes, and argued that by virtue of those sections the company had a right to exercise its functions as a telegraph company over roads declared by law to be military and post roads of the United States without being subject to taxation by the State authorities.

The court holds in its opinion that the statute which grants telegraph companies the privilege of running their lines through and over any portion of the public domain and along post roads is merely a permissive statute, and that there is no expression in it which implies or confers any exemption from the ordinary burdens of taxation. While the State cannot interfere to prevent the telegraph company from placing its lines along these roads or to stop the use of them; nevertheless, the company receiving the benefit of the laws of the State for the protection of its property and its rights is liable to be taxed upon its real or personal property the same as any other corporation or person would be. It never could have been intended by Congress in conferring upon a corporation of one State the authority to enter the territory of any other State and erect its lines therein, to establish the proposition that such a company owed no obedience to the laws of the State into which it thus entered and was under no obligation to pay its fair proportion of the taxes necessary to the State's support. If the principle now contended for be sound, every railroad in the country should be exempt from taxation, because they have all been declared to be post roads, and the same reasoning would apply with equal force to every bridge and navigable stream throughout the land.

The tax in the present case, though nominally upon the shares of the capital stock of the company, is in effect a tax upon that organization on account of property owned and business done by it in the State of Massachusetts, and the proportion of the length of its lines in that State to their entire length throughout the whole country is made the basis of ascertaining the value of that property and business. We do not think that such a tax is forbidden by the acceptance on the part of the telegraph company of the rights conferred by section 5,263 Revised Statutes. The tax assessed against the company is therefore a valid tax, the judgment of the court below "that the sum claimed by the plaintiff to be due for taxes, namely, $10,618, to be paid to said State by the company, with interest thereon," is without error, and so much of that judgment is affirmed. That part of the decree of the Circuit Court, however, which awards an injunction to restrain the company from carrying on its business in the State until the tax shall be paid, is reversed, for the reason that if Congress had authority to say that the company might construct and operate its telegraph over these post roads, as we have repeatedly held it had, the State had no authority to say that it shall not be done. Opinion by Justice Miller.

An Electrically Controlled Diaphragm Valve.

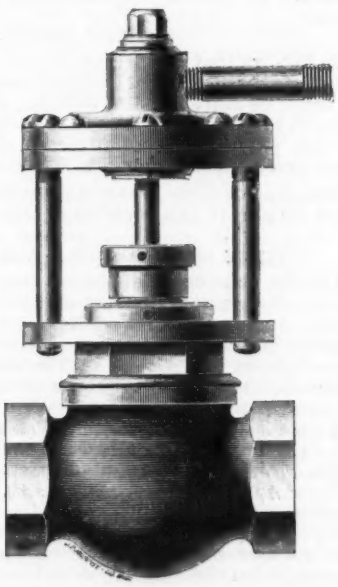
The accompanying illustration represents a novel arrangement of a diaphragm valve designed for use in connection with automatic electric heat regulating devices. The valve which is made by the Mason Regulating Company, of Boston, is intended to take the place of the ordinary globe valve in the steam supply pipe to the heating system. A thermostat is placed in the room, and has an electrical connection with a device to control the pressure, which is admitted through the small tube seen at the top of the valve. The valve is arranged with a metal diaphragm above, and connected to the main valve by a vertical stem. The pressure, which is controlled by the electric mechanism, is admitted through the inlet tube, to the upper side of the diaphragm, thus forcing it down, and shutting off the steam supply from the system. The valve remains shut until the temperature of the room is sufficiently reduced to act upon the thermostat, when the pressure is removed from the diaphragm and the valve opens.

The New "Law" Battery.

In the new form of battery designed by the Law Battery Company, of this city, the negative electrode has been altered somewhat in form from that heretofore employed. As will be seen, Fig. 2, it now consists of a corrugated cylinder, bolted to a conducting carbon, which passes up through the glass cover and serves as the attachment for the binding post. In order to avoid the creeping of salts the conducting plate is saturated with paraffine, and to prevent all action on account of the clamping device, the bolt and the nuts which secure the cylinder to the conducting plate are made of hard rubber. One side of the cylinder, it will be noted, is hollowed out, and in this space the zinc passes down from the cover. The construction of the latter is such that it holds the zinc securely in place without it being possible for the latter to come in contact with the carbon and short-circuit the battery under any conditions. The cell, Fig. 1, is sealed by means of a rubber washer under the cover, which prevents evaporation and the entrance of dust, the cover being kept tight by lugs which screw into the glass jar.

Another improvement to which attention may be drawn is the device employed for obtaining a good contact between the conducting wires and the binding posts. To effect this, the screws entering the posts are tapered conically at their ends, and the holes into which the wires are inserted are not, as usually, bored centrally through the post, but somewhat at one side of the centre. The result is that upon the insertion of the wire the tapered end of the screw forces the wire to one side like a wedge, and this action, combined with the grinding of the screw when turned, serves to make a perfect contact between the wire and the post.

FIGS. 1 AND 2.—THE NEW LAW BATTERY.



ELECTRICALLY CONTROLLED VALVE.

The Unit of Resistance.

To the Editor of The Electrical World:

SIR: Will you please answer the following: (1.) What is the difference between the Siemens unit of resistance and the standard ohm? (2.) Is the "Paris Congress" ohm now considered correct? E. R. R.

MANCHESTER, N. H.

ANSWER.—The Paris Congress defined the "legal ohm" as "the resistance of a column of mercury 106 centimetres long and 1 square millimetre in section, at the temperature of melting ice." The Siemens unit is the resistance of a column of mercury 1 metre long and 1 square mm. in section, at 0° C. (2) Many physicists consider 106.2 or 106.25 cm. as nearer the correct value than that adopted by the Paris Congress.—EDS. E. W.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, March 26, 1888.

The "Harpoon" Message Hook.

Among the many novelties recently introduced by The E. S. Greeley & Co. is the "Harpoon" security message hook and letter file, which has been devised specially for telegraph service. The security device in this hook consists of a gravity barb or tongue pivoted at one end, which drops naturally into the position at right angles to the hook. In filing a letter on the hook, the barb or tongue is forced up into a pocket and allows the paper to slide along the wire, making only a small round hole without slotting or tearing it. When the paper is filed the barb falls again into its normal position, preventing the paper from being pushed or blown off the hook. The device is at once so effective and cheap it cannot fail to find a large market.

An Electric Lighting Festivity.

The second annual ball of the employés of the Citizens' Electric Illuminating Company, of Brooklyn, will take place at the Palace Skating Rink, Clermont avenue, in that city, on Monday, next, April 2. The occasion promises to be highly enjoyable.

Mechanical Telephones.

It is thought in some circles that the recent Bell telephone decision will give a stimulus to work in the mechanical telephone field. Mr. T. G. Ellsworth, of 39 Nassau street, the general agent of the Knudson-Ellsworth telephone, tells me he is meeting with a very brisk inquiry and sale for the instrument, and he has several recent testimonials as to its efficiency. A number of telephones have been shipped to Cuba.

Taxation for Underground Work.

Judge O'Brien of the Supreme Court granted a preliminary injunction on March 20, restraining Sheriff Grant from selling out the Postal Telegraph and Cable Company, the United Lines Telegraph Company, and the Commercial Telegram Company because they have not paid their assessment according to State law, to provide for the salaries and expenses of the Subway Commission in laying out plans and methods of putting the wires under ground. The State Controller issued a warrant to Sheriff Grant to collect the assessment according to the mileage of wire in the city of the various companies. The amount apportioned to the Postal Cable Company was only $726, but it was not paid, as the company held it was unconstitutional, and the two other companies agreed with it. As a result, the Sheriff levied upon the companies, and was going to sell one out but for the protective influence of the injunction. There are several allegations made why the tax should not be paid. The Controller had apportioned $80,000 to be collected, $50,000 for New York and $30,000 for Brooklyn. It is charged that this is an unreasonable allowance for the Subway Commissioners and their expenses, and that the amount should certainly be not more than $15,000 to New York and $9,000 to Brooklyn. It was also alleged that any assessment by the Controller should be apportioned generally among the corporations assessable and apportioned between New York and Brooklyn. Several companies in this city had been left out of the assessment. Further, the charge is made that the Controller ordered the assessment without having received an itemized or detailed account of the expenses of the commission.

Leclanche Faradic Battery.

J. C. Vetter & Co., of 214 E. Forty-seventh street, this city, are making and putting on the market a Leclanché Faradic battery for which they claim good results. The apparatus is handy and portable, being only 8½ by 6¾ by 5¼ inches, inclosed in an ornamental leather case, or in fine woods. The firm are also engaged in the work of installing bells, burglar alarms, gas lighting apparatus, door openers, etc.

The Electrical Accumulator Company

reports a good demand for its batteries. A central station plant is now being installed at Detroit under the name of the Electrical Accumulator Light Company. The batteries will, I understand, be placed at different points along the line, each set lighting its own territory. Another central plant lately put in is that at Burrton, Kan. A number of gentlemen interested in piscatorial sport are devoting their attention to the use of small accumulator plants, which can, if necessary, be stored from primary batteries, and which will light lamps suspended from boats to attract fish. An idea that is also being worked at in the same way is the exploration of reservoirs, watercourses, etc.

In the Hoosac Tunnel.

I understand from the Standard Paint Company that the 100,000 feet of cable furnished for the lighting of the Hoosac Tunnel by the Standard Underground Cable Company was treated with the "P. & B." paint. The cable has now been in use some time, and has given great satisfaction. The Standard cable now in use by or being manufactured for the city of Philadelphia is treated in a similar way.

Steam Pressure Records.

I am sure that after the able presentation of the case by Mr. J. B. Edson at the Pittsburgh electric light convention, and the evident approval of all there of the system of keeping records, every local lighting company will see the necessity for using one of the Edson recording pressure gauges for its steam plant. There have been one or two lessons lately that should have their weight in this respect. A number of companies are now using the gauges, including those at Boston, Lynn, Reading, New York, St. Paul, Detroit and other cities.

The National Conduit Manufacturing Company.

Mr. George Westinghouse, Jr., and Mr. C. H. Jackson have been elected president and vice-president respectively of the reorganized company named above, which is now making a specialty of the Phipps underground pipes. The other officers of the concern are Mr. J. P. McQuaide, secretary and treasurer, and Mr. E. S. Perot, general manager. The Phipps pipe lies in the Church street underground section in this city, and is used by telegraph and telephone companies. A sheet-iron pipe is employed, with a lining of cement, which absorbs all moisture that penetrates and keeps the cables free from dampness. I saw a section of this recently which had been underground since 1868, and I could detect no material evidence of decay. The cement was as perfect as when first applied. The offices of the company are in the telephone building, in Cortlandt street, while the works are at Hastings, on the Hudson.

Private Telephone Lines.

The American Private Line Telephone Company, 45 Broadway, is introducing an entirely new system of acoustic telephones. Mr. G. Gehe, the manager, is well known in this field, having installed a great many lines. In the present case, the lines are not put in on a rental, but are sold outright, and maintained in working order at a stipulated price for any specified time.

Magnesia Exploders,

for photographic illuminating purposes at night or in dark places, are having quite a large sale by Mr. A. T. Smith, 6 West Fourteenth street, who has very ingeniously applied methods of electrical ignition, so that a number may be fired simultaneously. I have no doubt that electricians, so many of whom are actively interested in photography, will be glad to avail themselves liberally of the new opportunities of work thus offered.

The Union Fire Alarm Company.

This company, which has offices at 145 Broadway, has succeeded in obtaining another foothold for its system. The plant goes to the city of Austin, Tex., and consists of 25 non-interference boxes, 4 indicators, one ink register, two 15-inch gongs, one 6 inch gong, one tower bell striker, one galvanometer, 10 miles of copper wire, etc. The company was awarded the contract by unanimous vote of the council, and with the approval of the city firemen. The plant which was put in some time since in the city of Altoona, as I mentioned at the time, has received a full and unqualified indorsement from the authorities. To Mr. Charles Wann, of the company, who has just returned from Austin, the credit is due for the success scored in the face of very strong opposition.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, March 24, 1888.

Testimonial to a Station Superintendent.

On March 7, Mr. E. H. Mulliken tendered his resignation of the office of superintendent of the Cambridge Electric Light Company, to fill a position of emolument in a larger field. Having learned that on last Wednesday evening Mr. Mulliken would take his leave of the station, on that evening the employés presented him with a handsome silver water pitcher. Mr. Mulliken, in return, presented each employé with a large photograph of the interior of the station, a grouped photograph of all the employés, a cabinet picture of himself, and a letter of recommendation.

Removal of Chas. W. Trainer & Co.

Messrs. Chas. W. Trainer & Company have removed from 150 to 40 Oliver street, Boston. This firm is well known among the electric light people and manufacturers of New England. They are the northeastern agents for H. W. Johns' asbestos materials for covering steam pipes, boilers, etc.

A New Watchmen's Clock.

The watchman's electric clock, manufactured by the Eco Magneto Clock Company, of Boston, contains some features of merit worthy of consideration by those purposing to introduce a watchman's clock on their premises. This clock registers the visits of the watchman to each station, independent of all other stations, similarly to other electric clocks, but contains the novel feature of being without a battery, as the electricity is generated from a small magneto at each station, similar in principle to a telephone call, except that only one-quarter of a turn is necessary to make a record. This method of operating a watchman's clock possesses some advantages from the fact that the record can only be made from a station, and that no other means of interfering with the circuit exists by which record can be falsely made. The lack of any need of a battery in connection with this apparatus cannot fail to be a matter of great convenience to mills outside of cities. The offices of the Eco Magneto Clock Company are at No. 105 Summer street, Boston. Mr. Charles A. White is the general manager.

Another Consolidation of Electric Light and Gas Interests.

It is authentically reported that a consolidation of the New Bedford, Mass., Electric Light and Gas-light companies has finally taken place, on terms very satisfactory to the stockholders of the former company.

Personals.

Mr. G. L. Wiley, of the Standard Underground Cable Company of New York, favored this office with a visit last week. Mr. Wiley is keeping himself (and his company) informed of all the proceedings of the Boston Board of Aldermen in the hearings now under way regarding underground conduits.

Mr. Fred. Angell, representing J. A. Roebling Sons & Co., Trenton, N. J., manufacturers of telephone and telegraph wire—as well as every size and description of insulated wire—was on a business visit to the "Hub" last week. Mr. Angell reports that success has attended his trip throughout New England, and that his customers are pleased with the quality of the Roebling insulated wire, and particularly with the promptness with which orders are filled.

Julien Car.

Mr. Geo. B. Prescott, Jr., is still at his experimental operations at the electrical department of the West End Railway Company, Cambridgeport, Mass. Several trial trips of the West End Electric car, equipped with Sprague motors and Julien storage batteries, have been made during the past week, and everything worked satisfactorily. *Apropos* to the above, the following item is taken from the Boston *Evening Herald* of March 21:

Last evening President Whitney of the West End Railway enjoyed his first trip on the new Sprague electric car of that company. With him were ex-President Cummings of the Cambridge road, and other officials of the West End road, about 11 gentlemen in all. The car started from the stables at the corner of Harvard and Main streets, Cambridge, about 8 o'clock, for Bowdoin square. The ascent of the Cambridge street hill was made very easily and without much effort. Six and one-half mechanical horse-power was used. The car then went back to Cambridge, up Broadway to Harvard square, meeting another steep hill on that street near the colleges, which also was ascended very easily. The car made over 3½ miles an hour, including stops, on its trial trip last evening, 13 electrical horse-power being used. A part of the time five miles an hour was made. President Whitney was much pleased with the car, and expressed the opinion that such might be used to advantage in the outlying districts, although impracticable in the crowded city, because they could not go at full speed.

A Cable System for Cambridge, Mass.

At a meeting of the Cambridge Board of Aldermen, on Tuesday evening, March 20, the following order was adopted: "That the West End Street Railway Company may establish and maintain the cable system of motive power in operating its cars upon any and all the streets wherever it is now or may be authorized to run its cars in Cambridge, etc., etc."

"Booming" Bell Telephone Stock.

Great excitement has prevailed among telephone stock speculators in the Boston stock market during the past week owing to the decision of the U. S. Supreme Court on Monday, March 19, in favor of the Bell patents. On Tuesday, March 20, the Bell stock was quoted at 258 in the morning and run up to 260 during the day. On the opening of the market the following morning the stock referred to opened at 250, and during the day was carried up to 255, but at the close of the sales the price had fallen to 249. Since then the prices have fluctuated between 245 and 250. Commenting on the high rate now quoted for Bell stock the financial editor of the Boston *Herald* said: At 250 the stock nets 6 per cent., not a high rate for a stock which is in some sense still a patent stock, despite Monday's decision confirming its patents. Patents do not live forever, and the day will come when royalties will cease and income will depend upon the transmission of speech at moderate rates. One stockholder of the company said to-day that yesterday's decision added $100,000 to his wealth, and, whatever the future may bring, Bell stockholders are a merry lot to-day. New England climbed to 46, but could not hold there. Erie gained a fraction only to 31¼.

Underground Cables.

The Woodward Underground Telegraph Company's cables, comprising twenty miles of wire, have all been tested, and are in excellent working order. Within the next few weeks, with favorable weather, the cables will be continued through Lynn to Salem.

An Important Meeting.

On the afternoon of Tuesday, March 27, at 2:30 o'clock, there will be a meeting of representatives of electric light companies (parent and local) and the Electric Light Committee of the New England Insurance Exchange and its inspectors, to talk over equitable means for harmonizing the objects of insurance inspection and the effective installation of electric light plants desired by the different electric light companies.

Underground Conduits.

At a meeting of the Boston Board of Aldermen on Friday, March 16, a hearing was given to Henry E. Cobb and others, who ask for the exclusive privilege for twenty years to establish under certain streets conduits to conduct wires for telegraphic, telephonic, electric light and power communication. S. L. Powers, representing the petitioners, said Boston was behind other large cities in the matter of making provision for underground conduits. His arguments were made on the ground that it was for the interest of the city of Boston that such a system of conduits should be established. Col. R. M. Pulsifer said he was induced to sign the petition to the City Government mainly on account of the annoyance he experienced from wires over the tops of his buildings. The public long ago formed the opinion that these wires must go underground. J. M. Olmstead, counsel for the Spaulding Solid System of underground wires, appeared as a remonstrant, and said that his company was ready to furnish the wires for use by the city and to keep them in perfect repair. Mr. George S. Hale spoke on behalf of the Western Union Telegraph Company in remonstrance against the petition. He called Mr. Joseph W. Larish, electrician of the Western Union Telegraph Company, who claimed that his company desired to complete its underground system. Harvey N. Shepard made an argument on behalf of the New England Telephone & Telegraph Company in remonstrance against the granting of the franchise asked in the petition. Several prominent gentlemen opposed the petition, among these being C. J. H. Woodbury, on account of the fire indemnities; Mr. W. W. Gooch, on behalf of the Edison system, which had already wires underground; Prof. Charles R. Cross, of the Institute of Technology, who explained the danger of bringing electric light and dispatch wires together; Thomas B. Lockwood and E. A. Harrington, who objected to telephone wires being run with the light wires.

New Telephone Exchange at Providence.

The new operating room of the R. I. Telephone Company in the Butler's Exchange Building, Providence, R. I., was finished and all the wires connected up and in working order about a week ago. On Wednesday, March 21 through the kindness of Mr. A. C. White, the company's courteous manager, I was shown over the new quarters and had the pleasure of witnessing the working of the one wire multiple system, said to be the only one of the kind in use in New England. The new multiple switch-board is a magnificent piece of workmanship and artistic skill, and has a capacity of 5,000 subscribers. It is so constructed that the labor of the operator is lightened, and more prompt service rendered. The number of young lady operators is twenty-six. The superintendent of the operating room is Mr. W. E. Esten. The room is 80 × 30 feet, and has high vaulted ceilings. It being on the top floor of the building, the view from its windows is attractive. At night the operating room is lighted with incandescent lights.

Framingham, Mass.

The Framingham Electric Company has just been organized at Framingham, Mass., for the purpose of providing light, heat and power by electricity for that section, and a plant has been established at South Framingham. The capital stock is $100,000, and certificates of stock were issued to-day, over $60,000 having been taken. The officers of the company are as follows: President, S. O. Daniels, Natick; Secretary, H. L. Sawyer, South Framingham; Treasurer, Luther F. Fuller, Saxonville; Directors, H. L. Saw

yer, W. C. Woodward, L. F. Fuller, J. R. Entwistle, and S. O. Daniels. Most of the stock was taken at South Framingham.

Progress of Electric Lighting at Palmer, Mass.

Mr. Thomas T. Robinson, of the Thomson-Houston Electric Company, informs me that his station at Palmer is progressing favorably, and he expects to have it in operation by April 15. There will be 500 arcs and 500 incandescents (Thomson-Houston system) started up on the date named, orders being already in hand for that number. Many other orders for arc and incandescent lights are expected from the business men and residents of Palmer. The station will be operated throughout the year every hour that is necessary, thus affording the people better service by electricity than they had ever obtained by use of gas.

Electric Lights at East Greenwich, R. I.

Mr. Joseph Dews, owner of the Phœnix Woolen Mills at East Greenwich, R. I., owns and operates the electric light station in that town. The dynamos and other electric light apparatus are located in the mill building, and power is derived from the same steam plant which runs the woolen machines. The engines are run all night. The electric light equipment includes the following: One 40 arc-light Ball machine for street and commercial lighting, and a 500 incandescent light (alternating system) dynamo for domestic lighting. Mr. Dews is furnishing incandescent lights at a price equal to $2.25 for gas. The Academy in the town, which formerly made its own gas, has given up that illuminant and contracted with Mr. Dews to light the institution throughout with incandescent lights. Contracts are also in the hands of that gentleman for furnishing electric lights in all the churches. Mr. Dews deserves the gratitude of the citizens of East Greenwich for the incalculable amount of good he did, and is doing, for his town, more especially for his enterprise in the successful installation in their midst of an excellent system of electric lighting. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., March 24, 1888.

The Storm.

The unusually severe storm which visited this neighborhood last week not only put a complete damper upon business by the stoppage of railway communication, but made the blockade doubly strong by the almost total destruction of telegraph lines. The lines between New York and Washington will have to be almost entirely rebuilt, there being, it is said, no fewer than 1,000 poles down between these two points, and the repairs which have been made since the storm abated have been of a temporary character. All of the telegraph companies lost all of their lines between the points named, with the exception of the Postal Company, which had during all the week at least one wire to Baltimore, which gave them communication with all points. The long distance telephone lines, of which there are eleven between this city and New York, did not fare quite as badly as did the telegraph lines. Five of the telephone wires remained in working order most of the time, and the continuous use of them by newspapers and railroad officials brought a veritable harvest to the company. The electric light wires in the city which still remain above ground fared comparatively well, very few of the circuits being injured.

Draughtsmen's Materials.

Thomas H. McCollin, of No. 635 Arch street, reports an unusually good demand for draughtsmen's sensitive blue paper, which is being extensively used for printing plans and drawings of electric light plants. Excellent work can be turned out by the use of this paper.

Telephones for the Militia Armories.

City Councils Electrical Committee have decided to report favorably upon bills for the erection of telephone wires and the rental of telephones for the different armories of the State militia; and authorizing the erection of 231 additional electric lights in various parts of the city. The ordinance regulating underground service was so amended as to require that the pavings over openings shall always be kept in repair by the corporations to which the privileges may be granted.

Rapid Transit.

The Rapid Transit Electric Railroad Company, a newly incorporated organization, with its office at No. 26 South Third street, last Tuesday placed upon the desks of all the City Councilmen, at their special meeting, prospectuses containing a request that it be allowed the use for three months of the abandoned and disused tracks on Poplar street for the purpose of demonstrating the practicability of its plans. The motive power is electricity transmitted from a copper bar in a conduit under the track to a motor in the car. The sum of $1,000,000, payable in twenty annual installments of $50,000, is offered for the privilege of running cars over a double-track route from Twenty-ninth street and Lehigh avenue to Fifth and Minor streets. The officers are: President, Hiram Miller; Vice-President, W. A. Levering; Secretary, Theodore K. Vogel; Treasurer, Samuel A. Newman; Directors, S. P. M. Tasker, J. B. Mencke, W. A. Levering, C. N. Apple, Lewis Eckel, Franklin Noble and Hiram Noble. These gentlemen are also the incorporators, with the addition of N. E. Janney and Crawford Spear. The request of the company was not brought formally before Councils. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, March 24, 1888.

Progress in the Protection of Watches.

The Anti-Magnetic Shield and Watch Company have just received an order from one of the largest watch case manufacturers of the world for 25,000 of their well-known shields.

The Van Depoele Company.

The Van Depoele Electric Manufacturing Company, who have just sold to the Thomson-Houston Company their electric railway interests, will now push their electric light system, using the same generator as heretofore. They will also manufacture their motors for use in foreign countries, the Thomson-Houston Company having the exclusive right of manufacture in the United States. All existing contracts for electric street railways will be filled, and their present plant maintained. They have just sold to the Rockford Electric Power Company a large power plant, consisting of a 150 h. p. generator and a large number of motors. The plant will be operated by water power.

Personals.

Mr. F. W. Cushing, of the Chicago Arc Light and Power Company, left this week for an extended trip throughout California, Mexico, etc. The trip will consume at least a couple of months, and will give him a much needed opportunity for rest and recuperation.

I am indebted to Mr. Forée Bain for a handsome, framed lithograph of the combined voltmeter, ammeter and galvanometer recently designed and constructed by him for the U. S. Government.

Clean Machinery.

The Matchless Metal Polish Company report highly satisfactory results from their advertisement in THE ELECTRICAL WORLD, having already in a very short period of time received over 50 inquiries and requests for trial samples from superintendents and chief engineers of electric light plants. I was shown to-day while in their office a number of letters with orders from electric light engineers stating that the Tripoline was the most rapid cleaner and best polisher they had ever used.

Street Railway Projects.

I clip the following from the Chicago *Journal* of recent date: An effort is now being made to secure the consent of property-owners on North Ashland avenue to grant permission to lay a street railway on that thoroughfare to a new street railway company. They promise to haul their cars by electric motors, and get an entrance to the South Side by way of Jackson street when the new bridge is finished. A strange feature of the scheme is that they will not disclose the names of the capitalists backing the enterprise, and as the West Division Company obtained the necessary consent for the same purpose some time ago, it looks as if some job might be in course of incubation.

The Pratt Electro-Therapeutic Supply Company.

The Secretary of State at Springfield issued on March 21 a license of incorporation to the Pratt Electro-Therapeutic Supply Company, Chicago; capital stock, $100,000; incorporators, W. A. Stanton, W. Lebarxon, George Bloss and others.

Doings in the City Council.

At the meeting of the City Council Monday night an ordinance was introduced granting the Chicago City Telephone Company the right to lay telephone wires underground within the district bounded by Chicago avenue, Ashland avenue, 22d street and Lake street. Outside of that district it is proposed to erect poles. The ordinance was referred to the committee on fire and water.

Elevated Roads.

The "L" road ordinance previously submitted to the Council by the South Side Rapid Transit Company, upon the receipt of a favorable legal opinion from the Law Department as to its legality, was passed by a vote of twenty-nine to four. The ordinance compels the company to proceed to procure the land within sixty days, and it is to deposit with the city $100,000 cash in place of a bond. The company proposes to purchase outright the property along the route, to construct the road in a substantial manner, and in such a way as not to interfere with the rights of property owners, the protection of property in cases of fire, or public traffic. The exact route is not fully decided upon, but it is expected to start from Van Buren street and run to 67th street. Col. A. F. Wolcott, of New York, is engineering the scheme in the interest of New York capitalists, and it is understood that operations are to be commenced at once.

The Cushman Telephone Company.

I am informed by Mr. D. C. Boley, General Manager of the Cushman Telephone and Service Company, that the recent decision of the U. S. Supreme Court in the matter of the Bell Telephone Company is considered by his company as being most favorable to their case, which is now pending in the U. S. Court before Judge Blodgett. He states that the evidence is all in and that the case will be argued as soon as it can be reached. He further informs me that the points involved are different from the ones decided at Washington, their case resting on the claim that Dr. D. C. Cushman discovered the process and art of sending articulate sounds by means of electricity in 1851 and put it in use; that what Cushman discovered in 1851 includes the receiver—all that is in the Bell patents of 1876 and 1877, and that the transmitter which has made the telephone valuable as a means of communication was not patented until two years after the Bell patent. Mr. Boley states that if they prove that this is a fact, the court will hold that Cushman dedicated his discovery to the public, and hence that part of the recent decision relating to the Drawbaugh failure to perfect his invention cannnot affect the Cushman case.

The Electrical Supply Company

have just taken the exclusive agency for the A. J. K. patent spark arrester for preventing the sparking on dynamos and all electric machinery. It is in the form of a compound, and is applied to the commutator, and besides preventing sparking, it is claimed to prolong the life of the brushes.

Munson & Co.

Munson & Co., manufacturers of the well-known "Eagle" and "Dynamo" belting, report a number of sales with a very flattering prospect of a heavy spring trade in their special endless and rivetless belts for dynamo use.

The Western Electric Company.

Although the high price of copper is having a visible effect upon the electric lighting business throughout the country, the Western Electric Company still continue to be very busy in most of their departments. They report a very brisk trade in the Patterson cable, which is being so satisfactorily used in the different sections of the country. Among recent sales they report orders from Milwaukee, Louisville, Kansas City, Detroit, Buffalo and Chicago.

Jamestown, Dak.

In my notes of last week I mentioned the fact that the installation of an electric light plant had just been completed at Jamestown, Dak. I am just in receipt of a letter from Mr. L. A. Carr, of the firm of Carr & Co., contractors for electric light and power plants, Milwaukee, Wis., stating tha he had the matter of the construction of the plant wholly under his supervision, Mr. H. A. Stucky, whom I referred to, being in his employ. In the absence of Mr. Carr, Mr. D. M. Stedman is acting as superintendent of the plant. Mr. Carr also states that everything in connection with the plant is in good condition and promises well for the future.

The Co-Operative Electric Light Company.

The Secretary of State this week issued a license of incorporation to the Co-operative Electric Light Company at Chicago; capital stock, $25,000; incorporators, Rudolph Brand, E. G. Halle, Harry Rubens and others.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$26@	$27
Central Union	47@	48	Michigan	78@	80
Chicago	375@	400	Missouri and Kansas	70@	72
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	65@	68	Wisconsin	108@	109
Great Southern	35@	40			

E. L. P.

ENGLISH NOTES.

LONDON, March 7, 1887.

The City Lighting Scheme.

It is satisfactory to note that the conduct of the Commissioners of Sewers in refusing the Brush proposal for lighting the city has called forth a storm of disapprobation from the daily papers; and a determination is vigorously expressed that the reproach now resting on the city of London, of being amongst the worst lighted cities in Europe, shall be effectually wiped away. For instance, the *Citizen*, an important metropolitan journal, says: "What the citizens of London demand is the electric light in some shape or form. They care not what company is employed, so they have the best light. This may be denied them by the Commissioner of Sewers, unless they bestir themselves." Other papers freely express the opinion that the conduct of the Maxim-Weston Company, in coming in at the eleventh hour with a bogus proposal, can only be explained on the supposition that their action has been promoted in the interests of the gas companies. There is no doubt that the electric lighting of the city streets will come to pass, notwithstanding all the forces which the powerful vested interests of the gas companies are able to bring to bear against it. But it is quite on the cards that their action may delay its adoption for another twelve months or more.

The House to House Lighting Project.

The House-to-House Electric Lighting Company, whose appearance on the scene with a magnificent flourish of trumpets I have already acquainted you with, has failed to get its shares taken up and is now inclined to sing very small indeed. "It is hoped," says the last official communication from the directors, "to establish a central station [somewhere] before the expiration of a year." This is a very different way of talking from that which they adopted less than a month ago.

Submarine Mining.

Some attention is being given to the question of establishing a "Voluntary Corps" of submarine miners for the defense of our mercantile ports. The *Army and Navy Gazette* has this week an article strongly in favor of the scheme, and it is hoped that many electricians will feel sufficiently interested to take an active part. It is, of course, unnecessary to say that the whole system of modern submarine mining depends upon the electrical portion of the apparatus, and it is clearly essential that the officers, at least, of the new corps should have a thorough technical acquaintance with electrical appliances.

Private House Lighting.

Marlborough House, the residence of the Prince of Wales, is being wired for incandescent lighting. The current will be supplied from the central station at the Grosvenor Gallery, by means of Ferranti transformers. There is still a steady demand for apparatus for isolated lighting, and for this purpose Spiel's petroleum engine is meeting with favor. The number of country houses lit by electricity is continually increasing. Amongst the latest I may mention Lord Brassey's residence at Normanhurst. His Lordship's town house in Park Lane is also lit from the Grosvenor Gallery central station.

Fire Alarms.

At the meeting of the Society of Telegraph Engineers, on Thursday next, we are to have a paper by R. Von Fischer Truenfeld on "The Present State of Fire Telegraphy." It appears to be generally admitted that in this country "the present state of fire telegraphy" is not of a very satisfactory character. Your readers will possibly be surprised to learn that it is only since the year 1880 that street telegraph fire alarms have been adopted in London. The result was seen immediately in the diminution of serious fires. Out of 100 fires in the year 1866, 25 are classed as serious fires and 75 as slight. Out of the same number in 1886, 7 were serious and 93 slight. When these fire alarms were first put up, a great deal of trouble was experienced, owing to the number of false alarms received. In fact, during the first year of their existence, no less than forty per cent. were false alarms. But, happily, this foolery, to call it nothing worse, is now almost entirely unknown. There are several systems of fire telegraphs in use in London, of which Sir Charles Bright's is probably the best known. There is, however, another ingenious system, which was brought out by the Single Wire Multiple Telephone Signal Company, and is now extensively employed. In this system any number of stations may be connected on a single wire, and not only can each individual call be distinguished, but two or more separate calls may be made independently at the same time, and will each register themselves separately at the fire station. But, although, as I have already said, the fire alarm system in London is by no means perfect, it is much better than in most of the large provincial towns. Amongst other places where public street call points do not at present exist may be named Liverpool, Manchester, Edinburgh, Bristol, Birmingham, Sheffield and Cork. In fact, it would probably be easier to give a list of the towns which *have* adopted the system, and so far as my information goes, I do not believe that the list exceeds seven or eight at the outside. I understand that in Mr. Truenfeld's paper he will devote a large space to a description of the American systems, with elaborate statistics of their use. The paper is looked forward to with considerable interest.

The Phonograph.

One of the evening papers, a few days since, devoted four columns of small type to an interview with Col. Gouraud on the subject of the phonograph. As a specimen of the art of interviewing in its most advanced and pertinacious form, this would be hard to beat. The colonel was evidently very unwilling to submit to the process, but found escape impossible. It does not, however, appear that the interviewer succeeded in extracting any information which is not already pretty well known to the technical world, except, perhaps, the fact that Edison is not yet satisfied with the present form of the apparatus, and is still working hard in order to perfect the minor details.

The Electric Lighting Bill.

The Electric Lighting Bill introduced by Lord Thurlow was read a second time in the House of Lords on Monday last, and the whole of the noble lords who spoke on the question expressed themselves in favor of the measure, Lord Herschell remarking that at the present time the electric light was more extensively used in the South Sea Islands than it was in London.

The Telephone Companies and the Government.

In the House of Commons yesterday Mr. Provand asked the Postmaster-General if there was at present any scheme for the purchase of the telephone companies' interests under consideration by the government. Mr. Raikes said that no scheme was being considered by the government for the purchase of the telephone companies' interest, nor was any such scheme in contemplation.

Seel Incandescent Lamps.

During the last few months a good deal has from time to time been heard of the Seel incandescent lamp, which is already extensively used in Germany. The method of making this lamp has been kept secret for reasons of a tolerably obvious character, but the following description of the process has recently come into my hands, which I give for what it may be worth. The filament consists of a thread of silk or wool which is impregnated with a solution of gum arabic and caustic soda, to which are also added some of the soluble silicates. The threads are passed between two hot cylinders and are then carbonized in the ordinary way. When finished the filament is surrounded by an envelope of silicate which is said greatly to increase its length of life.

THE TELEGRAPH.

Knoxville, Tenn.—The Board of Public Works is receiving bids for the fire alarm system.

Central and South American Telegraphs.—The annual report for 1887 of this company shows a revenue of $451,602, expenses and repairs of $135,965, dividends at 6 per cent. of $240,396, and a surplus of $201,001.

New York Taxation.—A bill has been introduced in the New York Legislature requiring all telegraphic companies to return to the State Comptroller and each county treasurer the extent of its lines in every county for tax purposes.

Commercial Cable Officers.—Mr. John W. Mackay was re-elected last week president of the Commercial Cable Company; Mr. H. de Castro, vice-president; Mr. C. C. Brown, second vice-president; Mr. E. C. Platt, treasurer, and Mr. G. G. Ward, secretary and general manager.

THE TELEPHONE.

Staunton, Va.—The Augusta Telephone and Telegraph Company will, it is said, shortly begin work.

Mississippi.—A bill has been introduced in the State Legislature to incorporate the Gulf Telephone Company.

Looks Like an Outrage.—It is reported that some of the employés of the Consolidated Gas Company have bricked up the man-hole in the conduit at the junction of John street and Broadway, this city, within the last day or two, and carried away the iron cover. The conduit contains about 800 telephone wires at this point.

"Stealing by Telephone."—A colored thief was arrested in New York last week who had made a number of "hauls" down town by going into offices, asking to use the telephone and then decamping with whatever he could lay his hands upon. The case is a good lesson for those who allow their telephones to be used by deadheads.

Pan Telephone in St. Louis.—A special dispatch from St. Louis, of March 21, says: The Pan Telephone system is in this city, and the recent decision by the Supreme Court of the United States has caused some uneasiness among the subscribers. That feeling was augmented to-day when several subscribers received a notice from the attorneys of the Bell Telephone Company demanding that all other than the Bell instrument be put out of service, and in case of refusal they threaten to bring suit. A lively meeting of the directors was held to-day. Vice-President Terry said the Bell people made no threats of suit, and he thought the case would be amicably adjusted. He did not think they would interfere with their subscribers either. He declared that the case was not settled yet by long odds. Mr. Terry, who is a lawyer, is at the head of the Pan Telephone here, and says there will be no retreating in the face of the enemy. He puts great stress on the fact that the court decided a question by a majority of one, and that Justice Lamar did not sit in the case.

Bell Telephone Finances.—The annual report for 1887 is expected to show a dividend balance of a trifle under 22½ per cent., against about 20 per cent. in 1886, and about 18 per cent. in 1885. The gain is some 2 per cent. a year, and this year's earnings should exceed 24 per cent. The company as yet divides only 15 per cent., 12 per cent. in quarterly payments and 3 per cent. extra. The increased income springs in part from the gain in the telephones in use, but mostly from income on sub-company stocks. The instrument output for the month ended March 20 is appended:

Month March 20.	1888.	1887.	Increase.
Gross output	4,106	4,372	*266
Returned	1,621	1,452	169
Net output	2,485	2,920	*435
Since Dec. 20.	1887-88.	1886-87.	Increase.
Gross output	12,108	11,751	357
Returned	5,381	5,326	55
Net output	6,727	6,425	302

*Decrease.

THE ELECTRIC LIGHT.

Conway, Ark., is talking electric light.

Terrell, Tex.—Mr. Cook is negotiating for a plant.

St. Paul's Cathedral, London, is to be illuminated by electricity before next winter.

Winchester, Tenn.—It is said that Girton & Smith will put in an Edison plant of about 200 lights.

Holyoke, Mass.—The George R. Dickinson paper mill at Holyoke is to have an electric light plant.

Nashville, Tenn.—The Nashville Jenney Electric Light Company has asked for a permit to erect its plant.

North Danville, Va.—A 30-light arc plant of the Thomson-Houston system will be put in by Mr. C. A. Ballou, of Danville.

Shelbyville, Tenn.—The plant to be selected and put in by W. A. Frost and others will include both arc and incandescent lights.

Kaukauna, Wis.—The Kaukauna Paper Company has replaced its old lighting plant by an Edison installation of 100 lamps.

San Antonio, Tex.—The charter of the San Antonio Gas Company has been amended, enabling them to put in an electric light plant.

Canandaigua, N. Y.—The Canandaigua Electric Light and Power Company has been incorporated by A. Grieve and others, with a capital stock of $50,000.

Eureka, Kan.—The Eureka Electric Light and Power Company has been incorporated by A. S. Van de Mark and others with a capital stock of $25,000.

Jackson, Miss.—A corporation whose name will be the Jackson Light, Heat and Power Company has been formed to put in water-works and an electric light plant.

Louisville, Ky.—The Kentucky Electric Service Company has been organized with a capital stock of $25,000. Mr. J. T. Gathwright is the president of the company.

Annapolis, Md.—The Annapolis Electric Light Company has been incorporated by G. Wells, T. Tunis, J. B. Seth, S. Harwood and others, with a capital stock of $100,000.

Amsterdam, N. Y.—The Loomis Electric Manufacturing Company, of Boston, has recently fitted up one of Sanford & Sons' large carpet mills at Amsterdam with an incandescent plant.

Little Rock, Ark.—The Little Rock Electric Light Company is looking into incandescent systems with the view of adding to its plant. The Citizens' Incandescent Electric Light Company has increased its capital from $50,000 to $100,000.

A Theatre Fire at Oporto, Portugal, occurred on March 20, through the setting fire of scenery by a gas jet. Over a hundred lives were lost. The electric light was resorted to in the the work of searching for the bodies of the dead.

On English Trains.—Four express trains on the Great Northern Railway are now lighted by electricity, and arrangements have been made to introduce it on the "Flying Scotchman," which runs between King's Cross and Edinburgh.

Columbia, S. C.—Mr. W. H. Garden, representing the Ball Electric Light Company, of New York, has been negotiating with the Columbia Street Railroad with a view to erecting a plant for running the cars by electric motors and for lighting the city.

With a Button-Hook.—An Eau Claire (Wis.) boy strolled into the Brush electric company's establishment and went to prodding the dynamo with a button-hook. The latter was drawn out of his hand, and short-circuited the machine in such a way as to burn out the armature. It will cost at least $400 to repair the machine. The youth will be laid up for some time from the effects of the shock he received.—*Omaha Bee.*

Geneva, N. Y.—Messrs. Giddings & Blaine, the proprietors of the Kirkwood Hotel, have made a contract to light their house with the Brush incandescent system, to be run from the local station. Over 100 lights of 16 c. p. will be installed, and a large incandescent of 60 c. p. will be placed in front of the hotel. The work will be done under the personal supervision of Mr. Charles Avery, the well-known superintendent of the Geneva Brush Company.

New Orleans.—A dispatch from New Orleans, of March 24, says: A United States Marshal to-day seized the plant of the Brush Electric Light and Power Company in this city to satisfy a judgment for $32,000 obtained against said company by the Westinghouse Electric Company, of Pittsburgh. The Brush Company has a bonded indebtedness of $50,000, with $4,000 accrued interest. Six hundred shares of the stock of the Brush Company of this city are held by the parent company of Cleveland, O. The remainder of the stock is held here.

Bucksport, Me.—A correspondent writes: "I see you say that Mr. Geo. H. Grant has 'hired an old mill' here for a plant. The facts now are that Mr. Grant has bought the steam mill with the intention of putting in a dynamo for lighting up the town, as talked of for some time. He is now making arrangements to furnish electric power to those who may want it, and it is almost certain that two clothing factories will use it, as well as Mr. Moses, the florist. Quite a number of the stores will take the electric light and many of the dwellings."

The Electric Light in Hotels.—A hotel clerk remarked as follows to a reporter of the St. Louis *Globe Democrat:* I am frequently asked the question whether it is cheaper to burn gas in large hotels or to use electric light all through the house. Of late it has been practically demonstrated that electricity is the cheapest light. A hotel expects to make what little profit there is in the business off the traveling or transient public. Now that class of people consists chiefly in drummers and tourists, who want and demand more for their money than any class of people on earth. They require more attention and cause more trouble and annoyance than any other class of people who pay the same rate. One of the biggest items in hotel expenses is the gas bill. The regular boarder retires at certain hours and turns out his gas. The drummer, ever alert for any scheme to further his own interests, has adopted a plan to "get even," as he calls it, with the hotels. Every one of them carries gas burners and a pair of pliers to put them on brackets or chandeliers. The average hotel gas burner is of the three-foot size, that is, burning about that number of feet per hour, which gives ample light for rooms under ordinary circumstances. But the drummer is not satisfied with this. He unscrews the three-foot tip and replaces it with his own six or eight foot burner, which he lights just as soon as he gets to his room, and lets it blaze away all night, giving enough light to illuminate a hall and sufficient heat to warm the room. The tourist is guilty of the same trick, and they make gas bills climb at an enormous rate. With electricity this trick is done away with and a big saving made.

Fitchburg Engines.—The Fitchburg, Mass., Steam Engine Company are reported very busy filling orders, and are shipping their engines to all parts of the country. They have just dispatched a 200 h. p. engine to the Mount Morris Electric Light Company, Harlem, N. Y., and two large boilers, pumps, etc., making a complete plant. They have also started the electric light stations at Orange, Mass., and Ware, Mass., furnishing the complete plant at the former place. They are building a 150 h. p. compound condensing engine for the Otis Bros. Elevator Works at Yonkers, N. Y., and two engines of 50 h. p. and 25 h. p. for a paper mill at Tokio, Japan. They have shipped recently a 150 h. p. and a 60 h. p. to the Bridgeport, Conn., Paper Company, and are doing a large business in fitting out electric light stations all over the country.

APPLICATIONS OF POWER.

Greenville, Miss.—Steps are being taken to incorporate the Greenville Electric Street Railway Company.

Electric Fire Engines.—The Boston *Manufacturers' Gazette* publishes a pithy article on the advantages of electric fire engines, whether the motor be driven by direct connection at the hydrant or be propelled by storage batteries.

The Hopkins Motor.—The St. Louis papers have the following: A few days ago Rev. William W. Hopkins, of this city, was granted a patent on an electric street railway, which has been pronounced by scientific experts who have examined it to contain the most feasible plan of conveying the electric current from the dynamo to the armature on the car of any yet invented. Mr. Hopkins is of an inventive turn of mind, and gives considerable time to mechanical research as well as to the study of theology. In his invention he proposes to convey the electric current through a conduit, just below the surface of the roadway, by means of a series of metallic bulbs, one of each being fastened to the ends of an elastic bar made of a non-conducting substance, the bars being placed lengthwise in the conduit and supported in the middle, leaving the ends free to vibrate. The current is passed from one bulb to another by means of wires. An elongated bar is arranged to pass through between the bulbs, breaking the current as it passes, and conducting it upward to the car, to which the bar is attached by means of an iron support, which extends through the slot of the conduit. The conduit is so arranged that it will protect the electrical conductor from the mud and water which drops through the slot. It is claimed that this system can be constructed and operated cheaper and more effectually than any yet produced. Mr. Hopkins has assigned a half interest in his invention to a business man of the city, who is negotiating with an Eastern syndicate who propose to give the system a trial.

MISCELLANEOUS NOTES.

The Graphophone is made the subject of a full page illustration by the New York *Daily Graphic* in its issue of March 23. The sketches are of a humorous nature.

A New Battery Company.—The O'Keenan Electric Manufacturing Company, of Brooklyn, N. Y., has been incorporated by W. M. Grinnell and others, with a capital stock of $100,000.

A Man of Light and Leading.—Some weeks ago Charles Baldwin, one of the best-known men of Lexington, Ky., was seized with a sudden and peculiar illness, lasting several days. Physicians afforded no relief, and he recovered as suddenly as he became ill. On his recovery he noticed one evening that his body in the dark gave off a steady light, visible 100 yards. The light is so strong that when Baldwin is nude an ordinary newspaper can be read by the light from his body at the distance of six feet. He is perfectly well and is not conscious of his power. Physicians say he is the wonder of the age.—*Pittsburgh Dispatch.*

Kind Words.—Our valued contemporary, THE ELECTRICAL WORLD, recently completed the fourteenth year of its publication, but during this period the WORLD has not always been known by its present title, for the early history of the paper was made while it bore the name of *The Operator*, a journal devoted to electric telegraphy subjects. As electrical science and practical utilization of electrical apparatus progressed, *The Operator* widened its field of usefulness, and with commendable foresight seized upon a new title, which stands as a finger-post to index the character of its contents. Always cheerful, ever bright and wholesome, THE ELECTRICAL WORLD is destined to fill a far more important position in the electrical world henceforth than its peculiar fitness has given it in the past. Here is to thrice fourteen years.—*Progressive Age.*

Edison's Phonograph.—A Boston man says that when Edison first thought of making a phonograph he perfected most of the details before even drawing a plan. When he had the idea well developed, he told an old German who made models for him to make a machine after a certain pattern. The inventor didn't hint what he wanted it for, but occasionally sent an order for a change or alteration to be made, without even looking at the model. Finally the German took the machine to Mr. Edison, who fitted a bit of tinfoil into it, turned the crank and spoke into the funnel the words of that famous poem beginning "Mary had a little lamb." The German looked on as though he thought that the inventor had gone crazy. Then Mr. Edison reversed the crank, and in that queer, piping voice now so familiar, the machine repeated the lines. "Mein Gott!" said the German throwing up his hands. "Mein Gott! it talks."—*New York Sun.*

PERSONALS.

Mr. Joseph Weiss, who has been experimenting at Jersey City with a storage battery car, died there suddenly of pneumonia last week.

Mr. W. H. Dopp read an interesting paper recently before the Buffalo Electrical Society on the subject of obtaining electricity directly from coal.

Mr. Morris P. Janney, at the meeting of the Franklin Institute, Philadelphia, on Wednesday evening, March 21, read an interesting paper on "Electrical Water-Level Indicators for Steam Boilers."

Mr. E. R. Weeks, the able and energetic general manager of the Kansas City Electric Light Company, has issued a very neat and pithy circular giving illustrations and descriptions of apparatus for lighting and power. Such work must of necessity be own reward in increasing the scope and variety of the company's business.

Mr. J. F. McLaughlin, of Philadelphia, has the following scheme for signaling in war: "The scouts or signal officers carry in their knapsacks six small incandescent lights of the different primary colors. These are connected a with very fine wire with a small battery in the knapsack. Attached to the small globes that inclose the lights is a very small oval electrical motor, operated by an independent battery. When one scout wishes to communicate with another, he sends one globe high into the air and then turns on the electric fluid that illuminates it. By the use of the different colored globes and by combinations a conversation of any length can be carried on by night at long distances. The invention will be patented in Europe, and an effort will be made to introduce it into the different European armies, as well as into the army in this country."

Lieut. J. B. Murdock, U. S. N., who is well known to electricians, especially in connection with torpedo work and instruction at the Newport, R. I., station, has been ordered to the "Omaha," on the China station, and has proceeded to Colon, on the "Pensacola." His last work before leaving has been to prepare a report on electric lighting installations for the U. S. men-of-war, a subject upon which, it will be remembered, he read an able paper before the National Electric Light Association last August at Boston.

BUSINESS NOTICES.

Frames of every description for show-cards and pictures can be had of William Levin, 37 Dey st. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

Lathes.—Mr. E. P. Bullard, of 62 College Place and 72 Warren street, proprietor of the Bridgeport Machine Tool Works, reports an active demand for their special make of engine lathes, turret head chucking lathes, combination centre bolt cutters and vertical boring and turning mill, all of which are specially designed for manufacturers of dynamos and heavy electrical machinery.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Hine & Robertson, 45 Cortlandt street, N. Y., are pursuing a novel method of inducing electric light companies to try "Eureka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or set of brass oilers and tray, 6 pieces, best made. This is an easy way to secure one of these necessary articles and get a packing indorsed by the most prominent electric light plants.

Lockwood's "Electrical Measurement and the Galvanometer" is

the Only Book

which explains in plain English and without algebra, so that everybody can understand by reading and without figuring, the principles and practice of measurement with galvanometer and rheostat. It furnishes complete plain instruction for resistance measurement of instruments, batteries, lines, etc., and for fault tests and much other valuable practical information which is no where else to be found so plainly given.

Cloth bound, large type, numerous diagrams and illustrations. Price $1.50 by mail, post-paid, to any address. J. H. Bunnell & Co., 106-108 Liberty St., N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MARCH 20, 1888.

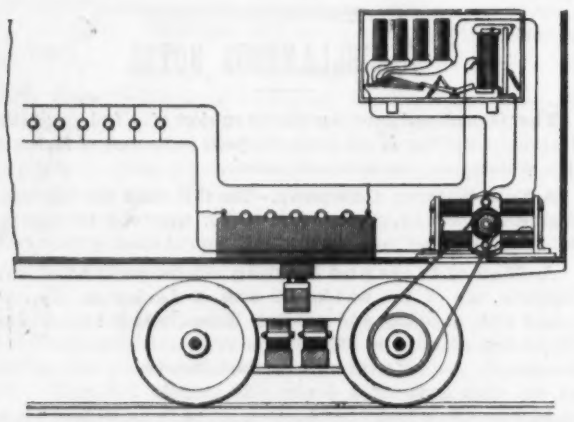
379,482. Socket and Key for Incandescent Lamps; G. Wilkes, United States Navy, Assignor of one-half to Louis Duncan, Baltimore, Md. Application filed March 23, 1887. A lamp cut-out consisting of spring terminals bent twice in opposite directions, terminal contact surfaces, a can-shaped button, and a key, whereby when the circuit is closed the spring terminals are given a slight reciprocating motion on the terminal blocks, keeping the contacts bright.

379,567. Application of Electricity to Car Lighting; Camille A. Faure, New York, N. Y., Assignor to the Electrical Accumulator Company, of New York. Application filed Nov. 16, 1887. Patented in France Nov. 9, 1881, No. 145,931. The second claim describes the invention substantially as follows: 2. The combination of a car or vehicle, a dynamo-electric machine having its armature mechanically connected with an axle of said vehicle, a secondary battery carried by said vehicle and electrically connected with said dynamo, and means for varying the strength of the field magnetism of said dynamo whereby the dynamo may be used to charge the battery. See illustration.

379,572. Storage Battery; Charles D. P. Gibson, New York, N. Y. Application filed Aug. 25, 1887. For description see page 162 this issue.

379,598. Plug for Making Electrical Connections; Gustav Otto, Jersey City, N. J. Application filed Nov. 26, 1887. A plate of conducting metal having a narrow projecting end, and a perforation at a distance from its end, through which a flexible conductor is adapted to be passed. The parts of the metal plate are to be doubled over, thereby clamping between them the end of the flexible conductor.

379,689. Dynamo-Electric Machine; Marcel Deprez, Paris, France. Application filed Dec. 7, 1885. Patented in



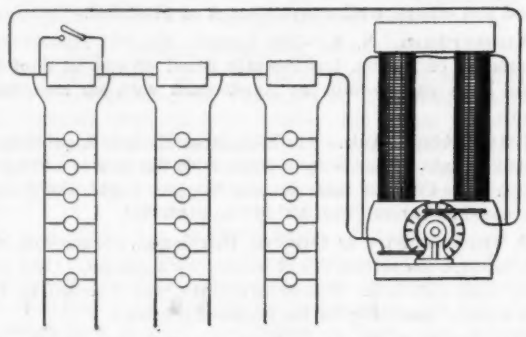
379,567. APPLICATION OF ELECTRICITY TO CAR LIGHTING.

France June 2, 1883, No. 157,832; in Belgium June 13, 1883, No. 61,690; in England, June 21, 1883, No. 3,074; in Germany Nov. 27, 1883, No. 30,405, and in Italy, Feb. 4, 1884, No. 6,546. The field of force is furnished by a series of independent electro-magnets placed in inductive relation to two separate armatures mounted upon the same shaft, and the arrangement is such that one pole of each electro-magnet acts upon one armature and the other pole upon the other armature. By this construction each electro-magnet may be comparatively small and may be magnetically saturated with the least expenditure of current, and the armature being also small, its magnetic poles will shift with ease.

379,758. Electrical Annunciator; B. N. Botts, Paso Robles, Cal. Application filed Oct. 1, 1887. A series of springs, each forming one of the terminals of the several circuits leading to the annunciator, bear against the periphery of a conducting disc which is in circuit with a motor rotating the disc and the pointer. A piece of insulating material is inserted in the periphery of the disc. When one of the circuits is closed, the disc revolves with the pointer until the spring terminal of that circuit strikes the insulating piece, when the movement stops.

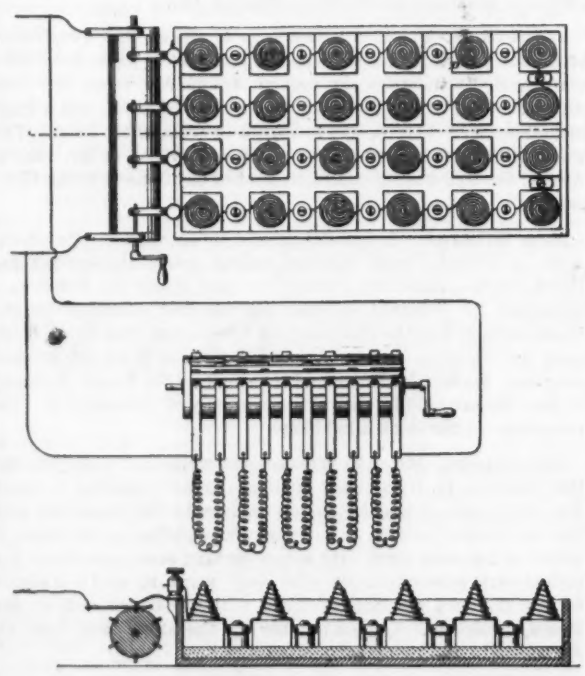
379,766. Tele-Thermometer; Fernando J. Dibbles, New York, N. Y. Assignor to Telemeter Company of New York. Application filed May 12, 1857. A thermostat consisting of a spiral strip located within a closed case, one end of the strip being secured to the case, and the other to a moveable arm which is geared to operate the contacts of electric circuits.

(1) 379,770. Incandescent Electric Lamp; (2) 379,771. Regulator for Dynamo-Electric Machines; (3) 379,772. System of Electric Distribution; T. A. Edison, Menlo Park, N. J., Assignor to Edison Electric Light Company, New York, N. Y. (1) Application filed Dec. 9, 1881. Patented in England, Oct. 23, 1878, No. 4,226. Italy, Nov. 21, 1878, No. 4,351 and 10,456. Belgium, Nov. 30, 1878, No. 46,567. Spain, Feb. 1, 1879, No. 128. France, Feb. 4, 1879, No. 127,341. Sweden, Feb. 8, 1879. Victoria, March 27, 1879, No. 2,632. Denmark, May 8, 1879. Norway, May 20, 1879. Canada, May 28, 1879, No. 10,031. Austria-Hungary, June 30, 1879, No. 30 and 864. Germany, March 10, 1880, No. 9,165, and Russia, Sept. 24, 1881. (2) Application filed Aug. 7, 1882. Patented in England Aug. 5, 1882, No. 3,576. Italy, Nov. 29, 1882, No. 14,825. Belgium, Nov. 30, 1882, No. 59,593. France, Jan. 18, 1883, No. 151,725.



379,772. SYSTEM OF ELECTRICAL DISTRIBUTION.

Spain, April 4, 1883, No. 3,736. Germany, Dec. 21, 1883, No. 25,000. (3) Application filed Aug. 7, 1882. Patented in England Aug. 5, 1882, No. 3,752. Italy, Nov. 14, 1882, No. 14,758. Belgium, Nov. 15, 1882, No. 59,457. France, Dec. 13, 1882, No. 151,279. Spain, April 4, 1883, No. 3,737, and in Germany, July 26, 1883, No. 23,270. (1) Two filaments in the form of spirals are placed one within the other for the purpose of decreasing the radiating surface and increasing the resistance. (2) In a dynamo having a continuously wound bobbin and a single commutator, two or more circuits having currents of different tension derived from the commutator, and means for independently regulating the tension of the currents in the circuits. (3) The object in view is to produce efficient and economical means for dividing an electric current of high electromotive force or tension into a number of currents of lower electromotive force or tension, and for



379,822. ELECTRIC HEATER.

making all the translating devices operated by the currents of lower tension independent of each other. Such an arrangement makes a saving in conductors, since a high tension current can be used from the point of generation to near the point of consumption, and the translating devices can be made independent by a multiple-arc arrangement, as with storage batteries, etc. See illustration.

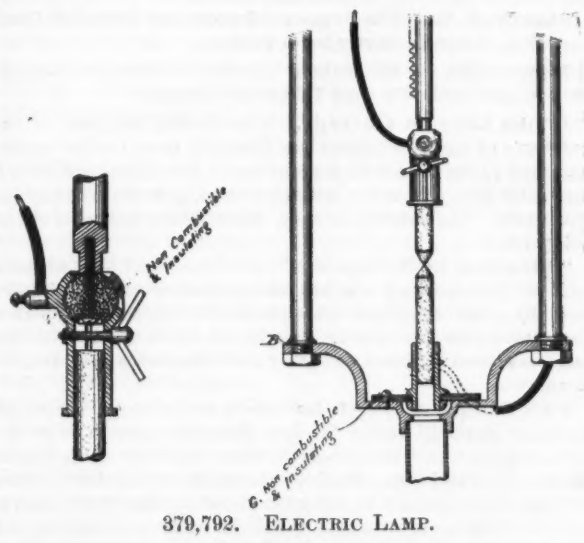
379,792. Electric Arc-Lamp; Edward R. Knowles, Brooklyn, New York, Assignor to Albert M. Kalbfleisch, New York, N. Y., and Mutual Electric Manufacturing Co., of New York. Application filed Dec. 3, 1885. The invention consists in the combination of a non-combustible insulating ball with the upper carbon rod and holder and a non-combustible insulating plate with the lower carbon holder and lamp frame, whereby the carbons of the lamp are insulated from the lamp-frame. See illustration.

379,802. Electro-Mechanical Movement; James F. McLaughlin, Philadelphia, Pa. Application filed July 20, 1887. The end of a pivoted lever is located between the poles of two magnets. The circuits and contacts are arranged so that the magnets are alternately energized, causing a vibration of the lever which may be converted into any kind of motion.

(1) 379,815. Apparatus for Increasing the Traction of Vehicles and Motors; (2) 379,909. Traction Increasing System for Electric Railways. E. E. Ries, Baltimore, Md., Assignor of one-half to Albert H. Henderson, same place. Applications filed Jan. 8, 1887. Methods of increasing the traction of a wheeled vehicle moving upon a metallic track, consisting in establishing and maintaining a traction circuit which moves with the vehicle and includes two or more wheels and that portion of the rails which extends between the same, and charging the circuit with a low tension current.

379,816. Electro-Magnetic Traction Increasing Apparatus; Elias E. Ries and Albert H. Henderson, Baltimore, Md. Application filed Nov. 7, 1887. The axles and wheels are converted into electro-magnets when the vehicle is traveling up a grade. The attraction between the wheels and the track then increases the friction between the two so that slipping of the wheels is prevented. The circuit of the magnet is controlled by suitable mechanical means.

379,820. New Mercuric Salt for Battery Fluids; Ander Schanschieff, Gipsy Hill, Assignor to the Schanschieff Electric Battery Syndicate, London. Application filed May 28, 1887.



379,792. ELECTRIC LAMP.

Patented in England Oct. 16, 1885, No. 12,378, and July 6, 1886, No. 8,832; in Germany Dec. 25, 1885, No. 36,415, and in India Oct. 15, 1886, No. 177. The solution is composed of yellow basic sulphate of mercury and bisulphate of mercury, dissolved in water.

379,822. Electric Heater; Carl Seiler, Philadelphia, Pa. Application filed Dec. 22, 1887. An electric heating device consisting of fire-proof insulating material having projections around and in contact with which heating conductors are placed. See illustration.

379,832. Electrical Stop Motion for Knitting Machines; Wait Talcott, Rockford, Ill. Application filed March 26, 1887. The yarn normally passes under a pivoted lever which is adapted when tilted to close a circuit. When it is necessary to stop the machinery the yarn is stretched and its tension tilts the lever, thus closing the circuit of a magnet, which operates to stop the machinery.

379,804. Elevated Railroad and Conduit for Electric Wires, etc.; Albert C. Oehrle, Philadelphia, Pa., Assignor to the American Pneumatic Railway Company of Tennessee. Application filed June 23, 1887. The top of the supporting columns are provided with extensions between which a conduit is built. The tracks are above and the ties are made movable so that access may be had to the conduit.

379,911. Galvanic Battery; A. Schanschieff, Gipsy Hill, County of Surrey, Assignor to the Schanschieff Electric Battery Syndicate, of London, England. Application filed Aug. 9, 1886. Patented in England Oct. 16, 1885, No. 12,378; Germany, Dec. 25, 1885, No. 39,415; India, Oct. 15, 1886. For description see page 167, this issue.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.